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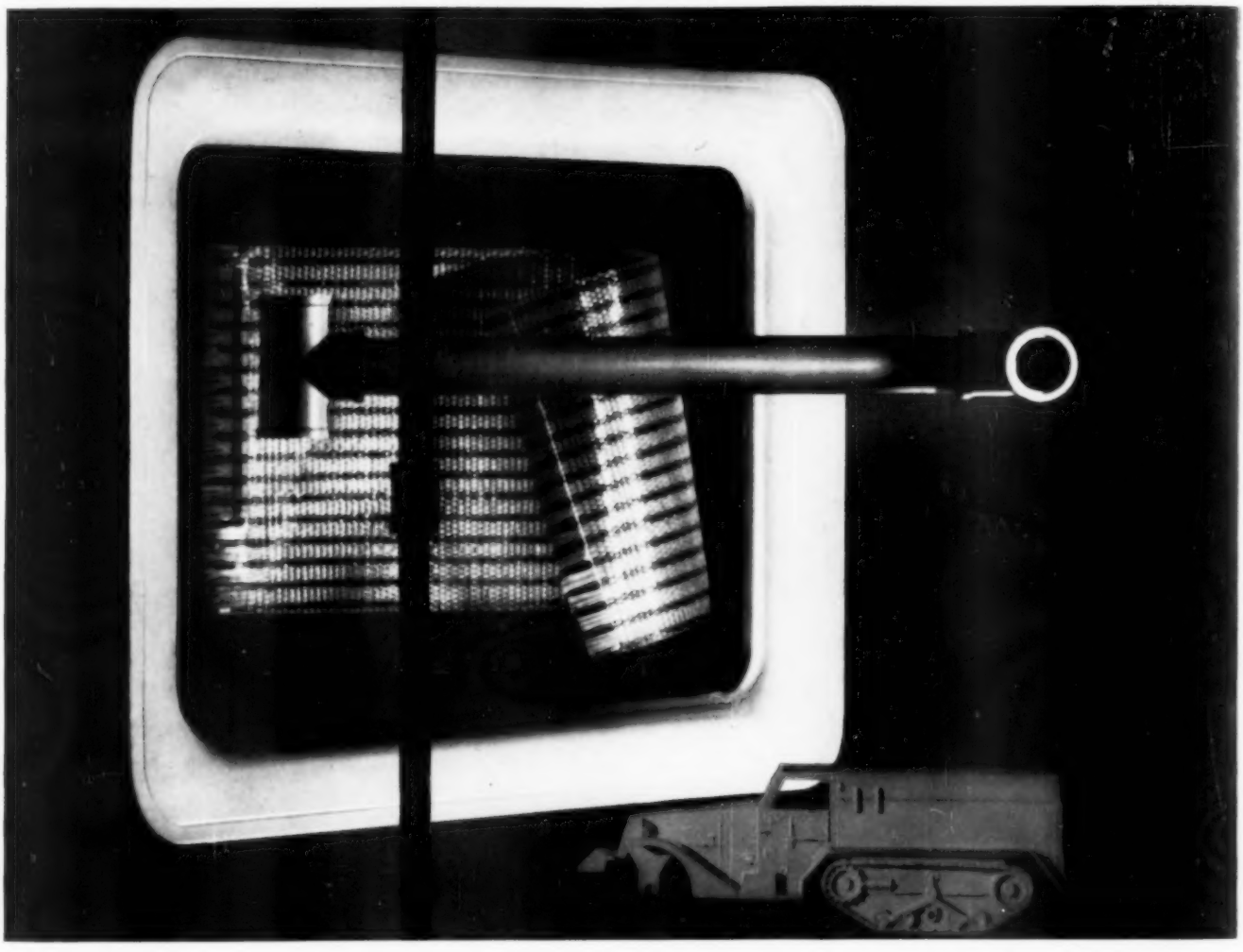
JOURNAL

VOLUME 8 NUMBER 3 • MARCH 1952

Photo courtesy of U.S. Rubber Co.

Fiberglas-polyester sport car body, molded in one piece, designed to fit standard chassis of 100-inch wheel base, is about 0.2" thick, weighs 185 pounds, sells for about $650. Designed by William Tritt (second from left) and manufactured by Glasspar Co., Costa Mesa, California.



THESE TOUGH NEW PLASTICS WANT TOUGH NEW JOBS

Outstanding shock resistance is the feature of new rubber-modified styrene plastics developed at Bakelite Company Laboratories. Shock resistance – plus excellent machining, chemical and electrical properties that fit them for many new, hard jobs!

These versatile new materials are offered at present in three grades. One grade has produced extruded gray pipe so tough that squeezing it nearly flat in a vise fails to crack it. At 0 deg. C., such pipe withstands a one-pound-ball drop test from nearly 80 inches. The same grade, extruded into rattan-like strips, provides economical woven chair seats of notable strength, flexibility, and beauty.

Another grade has provided black pipe that retains good impact strength even at sub-zero temperatures. A third, general purpose grade, offers the greatest moldability of the three types and is well suited to injection molding of large objects of thin cross-section. A white refrigerator door liner, for example, has passed prolonged slam tests. This grade also has been injection molded into colorful toy trucks and similar playthings that stand up under the mistreatment every Junior inflicts.

Impact strengths of these materials range from 1.0 to 10 foot pounds (Izod, per inch of notch) at room temperature. At minus 25 deg. C., the range is from 0.3 to 2.10 foot pounds.

Using conventional extrusion and molding equipment, these new materials offer promising economies and excellent performance wherever light weight, chemical resistance, good electrical qualities, color—plus high impact strength—are desired. Put them to work on your tough jobs. Write Dept. DS-43.

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RUBBER-MODIFIED
STYRENE PLASTICS

TRADE MARK

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A Division of
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JOURNAL

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First choice for the most jobs!

Uniform quality and consistently superior performance have made Durez 791 black general-purpose phenolic a standard in the industry for years. More molding plants use more 791 than any other single general-purpose material.

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Whenever you want a rich brown tone you get all the advantages of 791 in Durez 740. The two compounds are identical except for color.

Try these compounds on your next general-purpose production runs and enjoy the satisfaction of complete confidence in your moldings. Sample and data will gladly be sent—write to Durez Plastics & Chemicals, Inc., 1103 Walck Road, North Tonawanda, N. Y.

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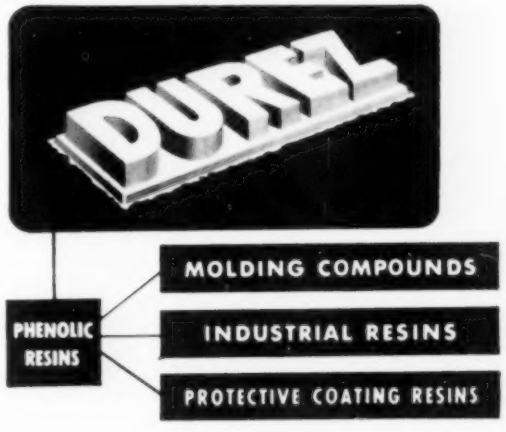
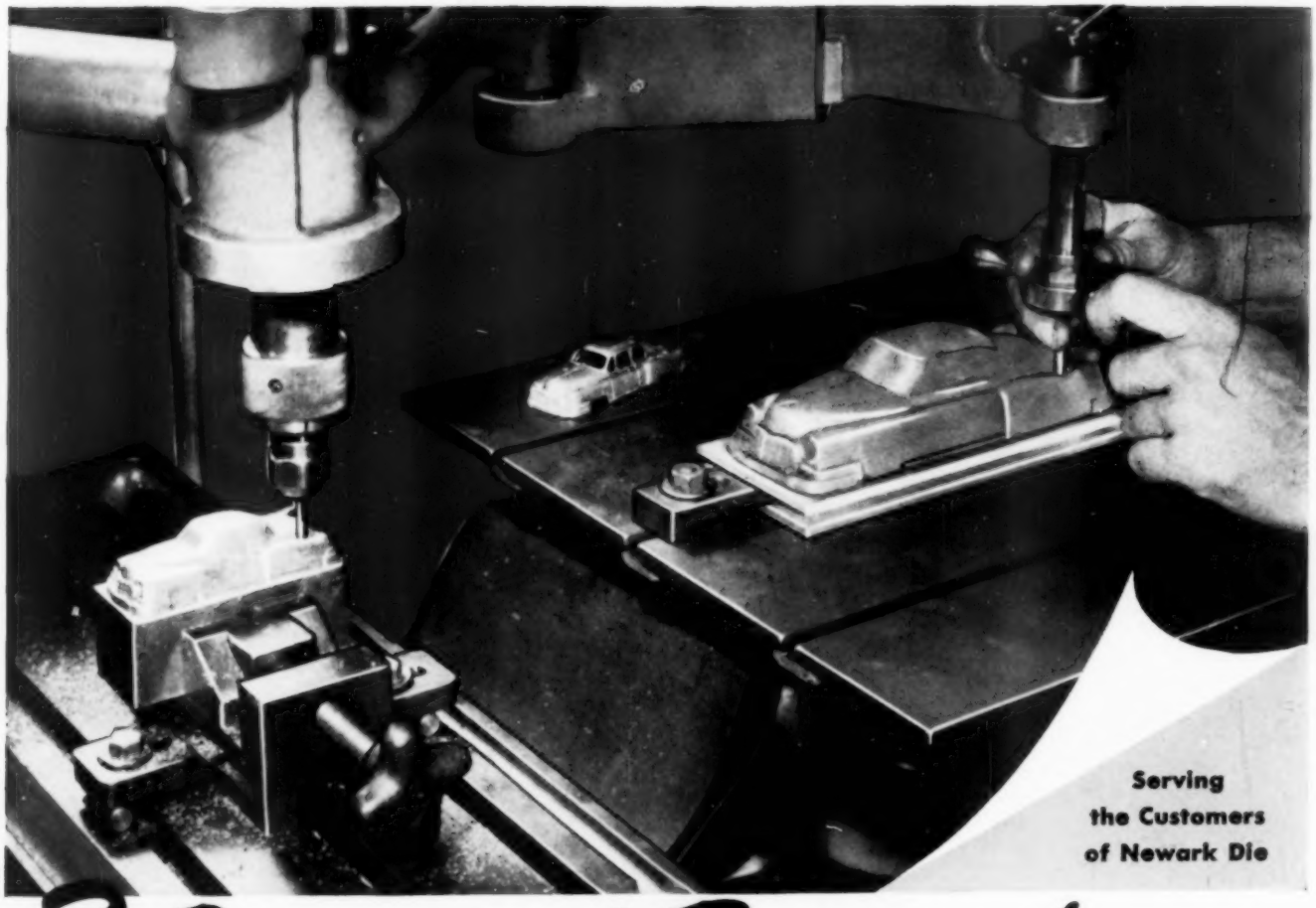


PHENOLIC PLASTICS *that fit the job*



3 Dimensional Pantographs

ENGRAVE DESIGNS FROM MODELS OF ALMOST ANY SHAPE OR CONTOUR

The hands of a skilled craftsman on the tracer of a 3-dimensional pantograph at Newark Die Company transmit the movement to the cutter spindle—to engrave designs quickly and accurately, regardless of shape or contour.

Through such modern machine tool facilities, the blueprints of Newark Die engineers are accurately translated into finished molds. Added floor space and modernized materials handling equipment now enable Newark Die to serve its customers with even greater promptness and efficiency.

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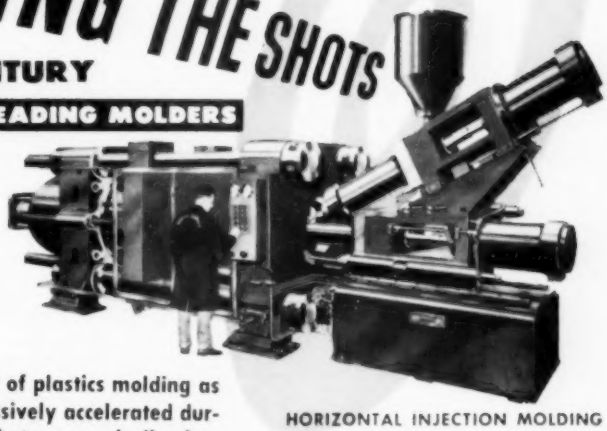
NDC TRADE MARK

WATSON-STILLMAN HAS BEEN...

CALLING THE SHOTS

Over
HALF A CENTURY
for **AMERICA'S LEADING MOLDERS**



HORIZONTAL INJECTION MOLDING MACHINES—12 TO 300 OUNCES

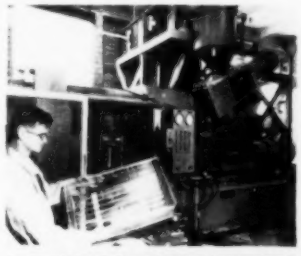
Growth and development of plastics molding as an *industry* has so impressively accelerated during the past few years that we are inclined to regard it as a youngster in *technique*. Actually, most current "innovations" in plastics equipment are rooted in experimental work going back more than 50 years to the days of celluloid collars and the first plastic billiard balls . . . to the pioneering days of Watson-Stillman research in what then gave slight promise of becoming the modern giant plastics industry of today.

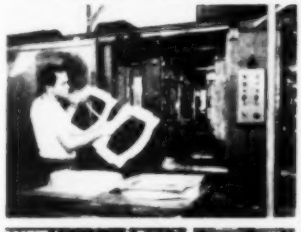
Throughout its 50 years of leadership in molding equipment manufacture, Watson-Stillman engineering has continued to "call the shots" on new materials, mold design, improved controls and, above all, on larger machine CAPACITY.

For instance, the presently popular "new" trend toward increasing capacity by means of *preplasticing* units was introduced by Watson-Stillman years ago . . . tested, improved, perfected through original research in shop and field by Watson-Stillman engineers . . . and has been successfully employed on Watson-Stillman units from 12 to 300 ounces capacity for years.

Each and every Watson-Stillman Machine is rated for its minimum capacity. This assures a margin of safety in Production . . . W-S Machines *deliver the goods.*

Today, as for more than fifty years past, it will pay you to consult Watson-Stillman *first* when you are molding by compression, transfer and injection techniques or when planning expansion or a new plant.





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W-S "COMPLETELINE"—SHORTEST DISTANCE FROM PRODUCTION TO PROFIT

HYDRAULIC MACHINERY DIVISION

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460 Fourth Avenue, New York 16, N. Y.

SPE PAPERS PRINTED ABROAD

The SPE Journal has concluded mutual reprint and abstracting rights with virtually every foreign plastics publication, with the following immediate results:

"Plastics" (England) has reprinted The Extrusion of Polystyrene by Goggin and McDonald from the September 1951 SPE Journal, and their February issue has Jerome L. Formo's "Conditioning Phenolic Materials" from the February 1951 SPE Journal.

The Swedish Plastics Federation is reprinting "Hobbing Cavities In Alloy Steels" by John L. Sekowski from the September 1951 Journal.

Australian Plastics plans on using our 1952 Conference Papers.

And Industrie des Plastiques Modernes plans on the Professional Activities Report "Mold Shrinkage of Thermoplastic Materials" by Sanford E. Glick from the May 1951 SPE Journal.

This is the best of world-wide publicity, and in return we hope shortly to bring to the SPE Journal those foreign articles of maximum importance, through the courtesy of our fine colleagues abroad.

NORTHWEST PENN. SELECTS OFFICERS

Paul C. Roche

The membership of the Northwestern Pennsylvania Section having been duly polled, the following is an up to date list of the section directors:

Dick Conner—Presque Isle Plastics; W. R. Byrd—Byrd Tool & Mold Co.; J. P. Quinn—Quinn Berry Corp.; P. C. Roche—Nosco Plastics; N. R. Reyburn—Applied Plastics; John Specht—Sylvania Elec. Prod. Co.; J. C. Stokes—Perry Plastics; Robt. Kling—Erie Resistor Corp.; W. C. Conroy—Erie Resistor Corp.

From this impressive aggregate of brass the following officers were installed at the February meeting of the Section:

President—W. R. Byrd; V.P.—Dick Conner; Secretary — John Specht; Treasurer—N. R. Reyburn; Nat'l. Director—W. C. Conroy.

This February meeting was held at the Sportsman's Club (formerly Pulakos-on-The-Lake) and was a technical and social success. The meeting was sponsored by Applied Plastics Division of Keystone Brass Works, under the able handling of Nat Reyburn. Naugatuck Chemical Co. provided the speaker, who covered their "Kralastic" thermoplastic material which has come into prominence of late.

Ed Roberts of General Electric Company has recently brought distinction to the section and to himself.

(Continued on Page 41)

with

METASAP STEARATES

PROBLEM: **How to obtain consistently perfect preforms and better finished products with maximum economy.**

ANSWER: **Plain as the hand of a "Plastiversal" machine in front of your face!**

In photograph A—the hand of the Plastiversal is registering 50 lbs. of pressure—the pressure required, at a leading molding plant, *before* Metasap Calcium Stearate was added to molding compounds. Such preforms were often badly delaminated upon ejection — as shown here.

In photograph B—the hand of the Plastiversal is registering 10 lbs.—all the pressure required to eject the same size preforms when they contained Metasap Calcium Stearate. Such preforms are obtained perfect in shape—as shown here.

Use of Metasap Stearates as lubricants in molding compounds results in:

Perfect Preforms—obtainable with lower ejection pressures.

Better Finished Products—because rapid, easy ejection results in clean-cut pieces with more marketable finish.

All of which means substantial production economies, longer mold life . . . increased output.

METASAP CHEMICAL COMPANY, Harrison, N. J.

Chicago • Boston • Cedartown, Ga. • Richmond, Calif.

Thomas E. Orr

Thomas E. Orr

It is with deepest regret that we note the passing of Thomas E. Orr, who died January 29th, at the age of 57.

One of the most widely acquainted and best known of our membership, Tom Orr labored vigorously and effectively for SPE since his accession to membership in 1943. He organized 15 SPE sections, including one in Mexico City and one in Quebec. He was national secretary in 1946 and president during the difficult year of 1947. He was awarded the highest honor SPE can bestow when he was elected Life Member in 1948.

He held degrees in Science and in Civil Engineering from Carnegie Institute of Technology, and served in both World Wars, holding in the last war the rank of Major in the Air Force.

Mr. and Mrs. Orr attended the 1952 SPE Conference in Chicago.

Tom Orr will be remembered best, not only as an indefatigable worker in behalf of SPE, but as a genial man, slow to criticize, quick and sincere to praise, a fine gentleman and real friend.

He was vice-president of Plastics Engineering, Inc., of Cleveland, and partner with Mrs. Orr in Plastray Corp.

The Board of Directors of the Society of Plastics Engineers, Cleveland-Akron Section, have passed a resolution to sponsor annually two junior memberships in the SPE, to be awarded to students of Case Institute of Technology and the University of Akron, respectively. These awards will be known as the Thomas E. Orr awards, which is an expression from the Society in appreciation of the outstanding work which the late Mr. Thomas E. Orr did in furthering the aims of SPE. The recipients of the award will be selected by the faculty of the schools on the basis of scholarship and interest in the plastic industry.

The President's Message

With two months having passed, your current Council has worked out a pattern of activities for furthering the aims of the Society. Only one phase can be summarized here, Professional Activities. Others will be discussed in later issues.

With regard to Professional Activities, we have adopted the policy of designating two competent and vigorous engineers as co-chairmen in each of eight areas throughout the country to head and select a committee in tackling a current plastics problem or project of interest to the industry. Since these committees will be in a regional area on work interesting to themselves, as well as the industry, the atmosphere of mutual interest and close association should result in achievement of their goal in minimum time. Walter Oelman, Vice President, will function as over-all coordinator in this work. It should be noted that functioning Professional Activities committees established in past years will still be actively encouraged and supported by the co-chairmen of the area to continue their work to completion.

The areas, co-chairmen and activities set up at the recent National Council Meeting in Philadelphia are listed below. Your participation in these projects will benefit you, your industry and the Society.

Area #1
Co-Chairmen: Sanford Glick and Edward Vaill
- a. Connecticut Section
- b. Eastern New England
- c. Rhode Island and Southeastern Massachusetts
- d. Western New England

Activity: Die design and molding technique for closed mold method of molding

Area #2
Co-Chairmen: Joseph Healey and I. Duviner
- a. Buffalo Section
- b. Toronto Section
- c. Northwestern Pennsylvania Section
- d. Rochester Section
- e. Quebec Section

Activity: Toxicity of plastics to employees
Polishing of Molds (Montreal)
Standard procedure for testing liquid resins (abrasion wheels)

Area #3
Co-Chairmen: A. Kaufman and A. Hutchins
- a. Newark Section
- b. New York Section
- c. Philadelphia Section
- d. Baltimore-Washington Section

Activity: Extrusion of Rigid Polyvinyl Chloride
Inspection Manual for Plastics (to be explored with Ordnance Corps, Wayne Schrag)

Area #4
Co-Chairmen: Ward Van Orman and George Field
- a. Cleveland Section
- b. Miami Valley Section
- c. Central Ohio Section

Activity: Electrostatic properties of plastics

Area #5
Co-Chairmen: D. Hoffman and J. Totten
- a. Detroit Section
- b. Toledo Section

Activity: Injection Molding Shop Practices
Water Absorption of Phenolics

Area #6
Co-Chairmen: Jerome Formo and Don Williams
- a. Chicago Section
- b. St. Louis Section
- c. Upper Midwest Section
- d. Northern Indiana Section

Activity: Revision of Military Specs. on Polyethylene

Area #7
Co-Chairmen: L. Barnett (and his selection)
- a. New Orleans Section
- b. North Texas Section
- c. South Texas Section

Activity: Compounding and Extruding

Area #8
Co-Chairmen: (To be selected)
- a. Golden Gate Section
- b. Southern California Section

Contact the man handling the work of most value to you. He'll welcome your cooperation.

W. O. Bracken

POSITIONS OPEN

PROJECT ENGINEER, preferably M.E. to handle product development of all thermoplastics with progressive New England Company. Experience in thermoplastics desirable but not essential. Send complete resume giving education, experience and salary commanded or required in first letter to Box 522, SPE Journal, 409 Security Bank Bldg., Athens, Ohio.

CHEMICAL ENGINEER
With background in injection molding of plastic materials to work with present Laboratory staff. Location—Eastern Pennsylvania. Give full particulars to Box 52-4 SPE Journal, 409 Security Bank Bldg., Athens, Ohio.

Gentlemen:

We are currently recruiting to secure the services of a Chemical Engineer who has had experience or special training in the field of plastics. The salary, between $4205 and $5940 a year, will be determined in accordance with the applicant's professional background.

In as much as this will be in a technical area which is relatively new to ordnance development, we feel that the position will offer excellent opportunities and a challenge to an engineer of unusual capabilities.

If this vacancy can be publicized throughout your organization we would be most grateful. To expedite consideration applicants should forward a completed Standard Civil Service Form 57 application and a list of courses or college transcript to the Head, Employment Division, Naval Ordnance Test Station, Inyokern, China Lake, California. Standard Form 57 can be secured at any first or second class post office.

Very truly yours,
GEORGE R. HICKMAN
Head, Employment Division.

"Extrusion of Vinyl Film" By A. M. Stover, February 1952 of the SPE Journal contained a printing error. In Table IV, on page 14, the column headings "Calendered 2 mil" and "Extruded 2 mil" should be reversed.

Extrusion of Acetate Sheet and Large Pipe

E. C. Blackard

Tennessee Eastman Company

The successful extrusion of cellulose acetate and butyrate demands adequately dried powder, and close temperature control in the die.

The extrusion of sheeting, especially in the thinner sheets, is aided by specially designed die lips, and careful attention to the spreader plate placement.

The equipment for extruding pipe up to 4" diameter is described, as is the process for extruding variegated strips.

This paper was presented at the 8th Annual SPE Technical Conference.

E. C. Blackard

Introduction

Both cellulose acetate and cellulose butyrate are furnished in pellet form for extrusion by the application of heat and pressure to force the plastic mass through a die to form sheets, rods, tubes and various other shapes. The method to be discussed does not involve the use of solvents. Furthermore it is planned to describe only features which are considered of unusual value to the extrusion of a better quality product and not cover the extrusion in complete detail.

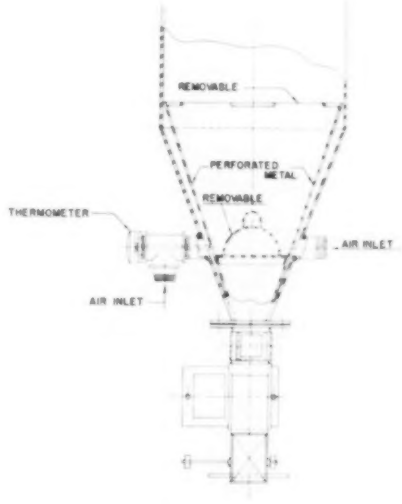
The extrusion of Tenite I (cellulose acetate) and Tenite II (celluose butyrate) has been carried on experimentally at Tennessee Eastman for approximately fifteen years. For at least ten years an Applications Laboratory has been maintained with the objective to develop the best possible technique. This information is passed on to customers by demonstrations, drawings and reports.

From this experimental work over the past years certain basic ideas have been proven about extrusion of cellulose acetate and cellulose acetate butyrate. Those principles which I feel are established I shall attempt to convey to you. In spite of much work done there is much yet to be discovered in extrusion work and you may rightly conclude that some principles could be explored much further.

A great percentage of our work has been devoted to the extrusion of sheeting of gauges from .001" to .060", the extrusion of pipe from 2" O.D. to 4.5" O.D., and the extrusion of shell variegated strip. The extrusion of small tubing and varied shapes of strips and rods became well known in the trade and it was felt that we could offer less help on these extrusions. It has been the aim, of course, to carry out work which would broaden the extrusion field and make this information available to interested customers.

Drying

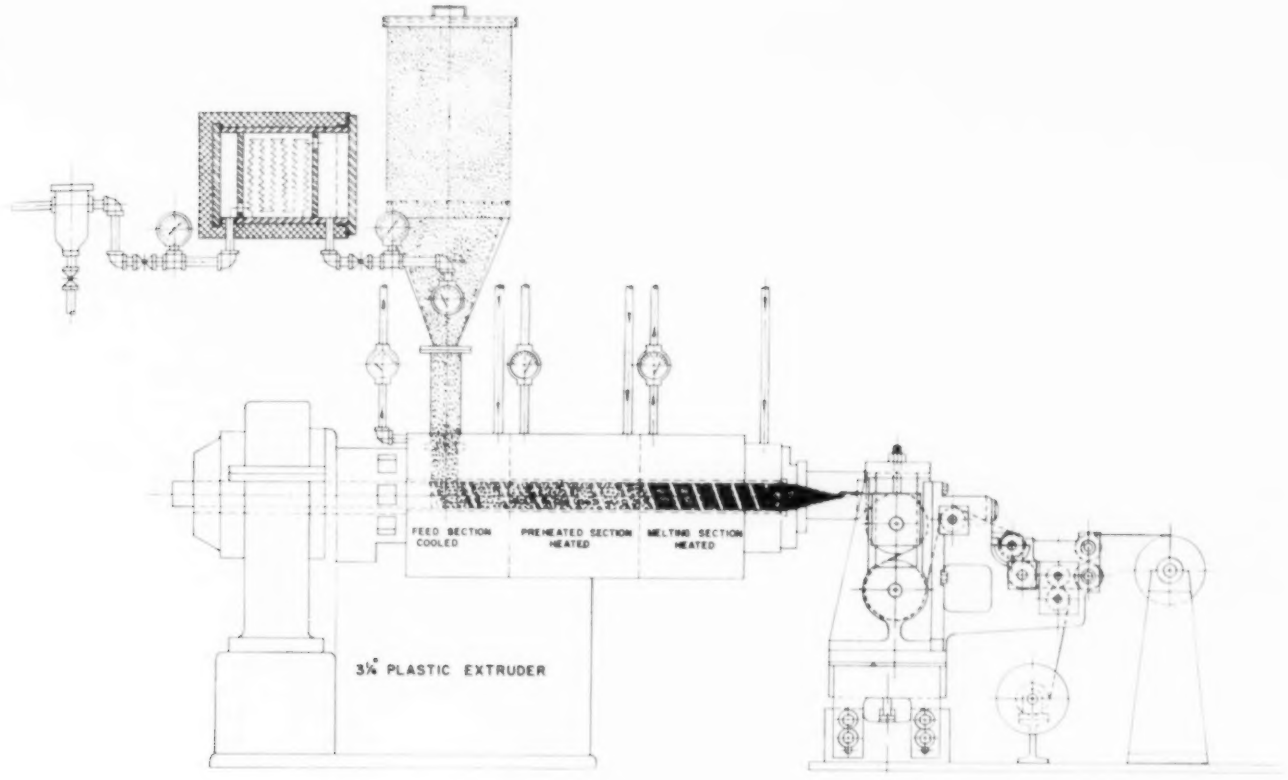
A drying hopper has proven advantages, not only in all extrusions of acetate butyrate but also in injection molding of these materials. For good extrusion the need for a thoroughly dried feed cannot be emphasized too greatly. The hopper dryer has been developed to insure this condition. One can see from the photograph that air is supplied into a hollow annular space at the bottom of the hopper and passed from this space through a perforated plate into the pellets. This air is heated from 150 to 170 degrees F., depending on the hardness of the material and it percolates up through the pellets escaping at the top of the hopper. The capacity of the hopper should be fifty per cent greater than the rated capacity of the extruder in pounds per hour, so that the pellets will be exposed to the hot drying air at least one hour. If continuous feed to this hopper is impractical it should be kept replenished at a rate to insure that the feed is exposed to hot air for one hour. As an example, on a 3¼" Royle extruder with a 36" screw the capacity of the hopper is 150 pounds so that we can safely allow 50 pounds to feed into the machine before refilling. It has been found that 80 c.f.m of free air at standard conditions is required to obtain thorough drying. The hopper shown is designed to use compressed air.



Drying Hopper

The compressed air is drawn from an 80 pound per sq. in. supply, passed through a water separator to entrap moisture, and then through an open coil electrical heater. The heater we have used is a 12 K.W. capacity which we find adequate for heating air required for extrusion rates of 100 pounds per hour. From the heater the air is controlled manually through a valve to the hopper. To force the air through the pellets about 5 to 8 inches of water pressure is required.

If a plant does not have compressed air available it is practical to use blown air which has been drawn through a filter and fin heater. This method of heating and supplying air



Equipment for Tenite Sheet Extrusion with Flat Die

has been used and is quite satisfactory, though the use of compressed air does give easier control of the flow and the temperature.

The perforated plate is removable for easy cleaning. Also, to prevent the pellets from channelling down the center a baffle plate is placed in the bottom of the hopper to spread the pellets to the outer circumference of the perforated plate.

What are the advantages of the hopper dryer over a tray dryer or a continuous belt dryer? First, with a hopper dryer the heated air surrounds each pellet to give uniform drying. It also eliminates the characteristic often evident in a tray dryer that the top layer of pellets is melted enough to have them stuck together in such a manner that the bottom of the layer of pellets does not dry completely. This condition could of course, occur with a hopper dryer if the temperature is not properly controlled, but normally it is not a problem. In very humid conditions if the material is standing in an unheated hopper of an extrusion machine it may pick up some moisture during the time it is feeding into the machine. Still another advantage is that with the hopper being entirely closed there is a minimum chance of contamination from outside sources.

It has also been observed that batches of pellets being supplied to the extruder hopper from a tray dryer will vary in temperature to cause non-uniform flow in the extruder. The uniformly heated material in a hopper dryer will give a more uniform temperature condition at the feed section of the extruder.

For these reasons and from our successful experience using a hopper dryer, it can be recommended as a proven piece of equipment.

Temperature

More work has been done in our laboratory on the extrusion of sheeting than any other type of extrusion.

One of the most important points to be emphasized in sheet extrusion is exact control of temperatures in the extruder and the die. From the drawing it can be seen that there are three sections in the extruder, the feed section which is cooled by water at room temperature, the pre-heating section and the melting section. The preheating section and melting section are heated by one source of circulating hot oil. This oil heater, however, is operated at a definite temperature and the temperature of the preheating section and the melting section are controlled by throttling the flow of oil into them. As an example, running 205-H2 Tenite II which is a common material for the extrusion of sheeting, the temperature of the preheating section might be 385 degrees F. and the melting section 400 degrees F. The temperature of the oil supply in this case would be maintained at 400 degrees F. Most of our work has been done using a circulating hot oil system, so that I cannot make a comparison between heating with hot oil or electrical heaters. A point to consider, however, is that hot circulating oil adds or extracts heat if frictional heat becomes great enough to cause the extruder to over-heat whereas direct electrical heaters would not serve such a purpose. And in extruding cellulose acetate or acetate butyrate frictional heat from the screw of the extruder is a factor.

But possibly this discussion is too basic to dwell on at length since temperature control is a common necessity in all thermoplastic work. I would like to point out, however, that wherever heat is applied a thermocouple is attached to the heated piece to control the temperature. On the extruder a band heater is used on the gate on which the die is attached and this is controlled by a thermocouple connected to a regulator. No heat is applied to the screw at all. For heating the die we have used both strip heaters and inserted heaters with equal success.

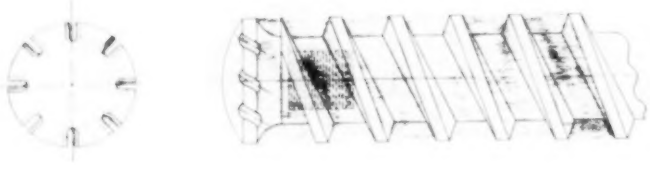
You will notice that the die protrudes very close to the top circumference of the top pull-out roll. The bottom edge of the die is cut at an angle to allow the die to come within

3" of the pull-out rolls. The sheet can be run at a higher temperature and dropped on these rolls without any difficulty in handling. The temperature of these rolls is controlled by a hot water circulating system so that heat can be added or extracted to maintain a constant temperature. The temperature is maintained as high as possible to prevent condensation of plasticizer and yet not have the sheet stick to the roll. These pull-out rolls are chrome plated and highly polished and actually the smooth surface of the rolls is imparted to the sheet to some degree. This arrangement has noticeably improved the surface finish of extruded sheeting.

The double set of rolls before and after the slitter holds the sheet firmly while it is being cut. The rotary slitters also cut a very smooth and straight edge.

Screw Design

Everyone who has worked with extruders has experienced trouble with surging or uneven flow of material from the extruder. The surging is to a great extent due to uneven flow from the screw. A rather simple alteration has greatly improved the flow of material to the die of the extruder. This removable tip is simply fastened to the end of a standard screw by drilling and tapping the end of the screw to receive the tip as shown in the drawing. The material feeding from the flights of the screw must pass through the slots of the tip, thus breaking up the rope of plastic from the flight of the screw. In this manner the material is cut and worked so that a more uniformly heated mass is delivered to the die. Just forward of the tip the usual screen and backing grid are placed. From my experience this simple device has maintained a back pressure on the screw to dampen out uneven delivery of material and it appears that it prevents a cold mass from depositing on the screen which may partially plug it until it is heated sufficiently to pass on through. This tip has been a greater help than any changes to the screw yet tried in an effort to obtain uniform flow. The alteration, of course, is one which can be made to existing screws and for that reason can be tried with little expense.



Throttling Tip for 3½-inch Extruder Screw

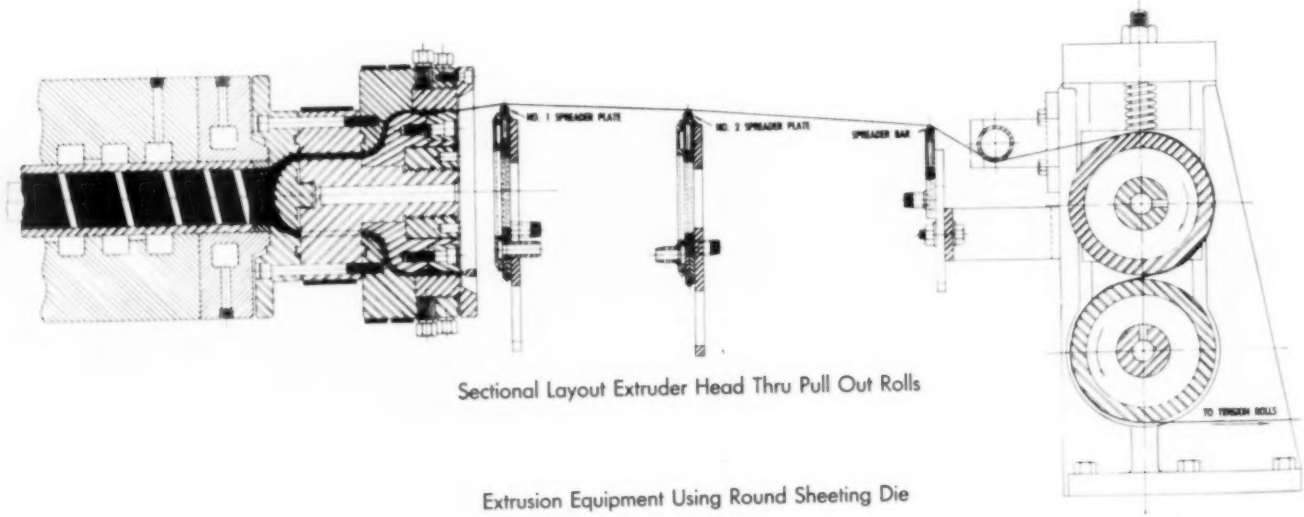
I know that immediately it occurs to you that this desirable effect caused by the screw tip alteration might be gained by a screw whose flights are so designed to give a uniform flow. It is my opinion that much could be accomplished in a complete study of screw design to give the proper compression ratio to cause a more uniform flow of material. Some work on this subject has been done but not enough to give conclusive results. It can also be said that variation in the tip design might give improved results. At least this work would be much less expensive to carry on and it would also be easier to alter present equipment. The tip shown which has given such good results restricts the flow approximately thirty per cent. The improved results were observed when extruding sheeting .040" to .060" thick. Formerly without the tip it was not possible to extrude this sheeting without ripples forming in the center of the sheet. With the screw tip hardly any traces of ripples could be observed indicating that they had been caused by the non-uniform delivery of material from the screw.

For a number of years all of the experimental work in the extrusion of sheeting was done with round dies. The round die does give a more uniform flow of material from the orifice since the hot material has an equal distance to flow from the extruder cylinder to the orifice. Also since the material is uniformly spread over a torpedo it is heated evenly. Yet with these advantages the real difficulty lies in handling the sheet from a round tube, slitting it at one point and drawing it across spreaders to flatten it.

Die Shape

You will recall in the first drawing the extrusion equipment using a flat die simply showed the pull-out rolls mounted as close as possible to the die with no cooling rings shown, whereas in the drawing below there is a maze of cooling rings, spreaders, etc. to attempt to get the sheet slit and spread flat without damaging its surface and causing strains to be set up by deforming it in a semi-cooled state. It is more difficult to handle the sheet from the round die. Sheeting thinner than .0075" cannot be extruded satisfactorily. On the other hand with a flat die, in most cases, no cooling is used. The sheet is cooled to approximately 200 degrees F. by contact with the pull-out rolls and after leaving them can be slit and wound up without any difficulty.

With cellulose acetate extrusions some difficulty is caused by plasticizer fumes forming underneath the sheet beteween the die and the pull-out rolls. The fumes sometimes cause a slight etching of the sheet. To prevent this condition a slight amount of air has been used to carry these fumes away but this set-up is not entirely



Sectional Layout Extruder Head Thru Pull Out Rolls

Extrusion Equipment Using Round Sheeting Die

successful for it causes a slight movement of the sheet.

Another solution not yet proven entirely is to draw these fumes away through a suction box. I do not mean to leave the impression that all sheet extrusion with the equipment as shown is unsuccessful due to this trouble but on some formulations and thickness it is a problem. With larger machines running at higher rates it would be a greater problem, and for that reason I have mentioned it with this suggested solution.

Flat Die

From our experience, in spite of the advantages in uniform flow in a round die, a sheet of better quality can be made with a flat die. In the figure below a section of the flat die which has given the best results is shown. In heating this die you will notice that inserted electrical heaters are used. These heaters are half as long as the die is wide. Eight heaters are used, four inserted from one end of the die and four from the other. It is felt that these heaters, as they are positioned, do offer the advantage of varying the temperature of the die. For an example, it has been found advantageous to maintain a slight differential in temperature between the front set of heaters and the set nearer the extruder. As an example on extruding a 205-H2 Tenite II material the front set is maintained at 385 degrees F. and the back at 400 degrees F.

The greatest difficulty in a flat die is to get uniform distribution of the hot material across the entire width of the die. There is a great tendency for material to flow directly through the center causing a thick section in the center of the sheet and also causing heavier gauge sheeting to have ripples in the center. To overcome this trouble a restriction is maintained just behind the die lips. This restriction causes the hot material to flow laterally across the width of the die before flowing on into the lips. The restriction also maintains a back pressure on the material to cause the voids and bubbles to be ironed out before flowing to the die lip. This restriction together with the screw tip previously described has made possible the extrusion of sheet free of ripples or "clouds." A "cloud" may be defined as an apparent thick or thin section which can be easily recognized as shadows of light or dark waves in a colored translucent sheet.

This idea of restricting the flow of material before the die lip is another point to be emphasized, especially in the extrusion of thicker sheeting. The need for using the idea has been further established in the extrusion of a heavier wall pipe.

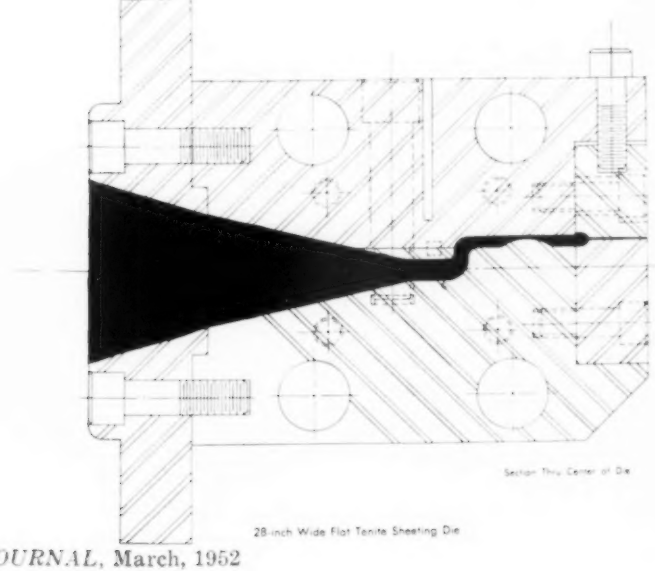
One of the basic aims in extrusion is to deliver a uniformly heated mass to the die and keep it uniformly heated until it issues from the die lip. For that reason thick sections are to be avoided. The offset section preceding the restriction where the material flows laterally in the die is kept comparatively thin and yet does act as a reservoir of material to maintain a constant pressure on the die lip. The change in flow characteristics with slight changes in temperature coupled with the material being a poor conductor present real problems in maintaining a uniformly heated mass in the die.

The material is very much inclined to stick and become over-heated on the hot metal while the center portion becomes non-uniformly heated when in thick sections.

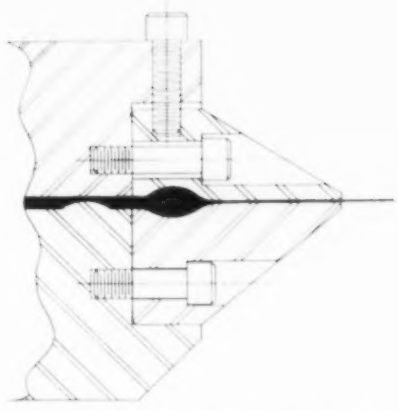
With the flat die, as shown, sheeting from .001" thick to .040" thick has been extruded.

Thin Sheets

The extrusion of very thin sheeting .001" thick is not truly the same process as with the thicker sheeting. It is done by drafting the sheet from a flat die sacrificing width greatly.



28-inch Wide Flat Tenite Sheeting Die



Die Lips for Extruding Sheets 0.04 to 0.06 Inches Thick

The die lip opening is .006" and from a 28" die lip .001" sheeting is drafted to 22" width but at rates of 50 to 75 ft. per mintue. This is surprisingly good quality sheeting. The greatest difficulty was experienced in slitting and winding this sheeting without its wrinkling. It was found that by careful alignment of all rolls and a very slight tension on the wind-up that it could be wound in smooth rolls. It is recognized that this sheet is not of a quality equal to solvent roll coated sheeting but it is felt that it is suitable for many wrapping applications or can be used as thin film for laminating work.

To extrude .040" to .060" sheet the die lips were changed and are shown in the figure above. The narrow die lips did not offer enough resistance to the flow of material to get a uniform sheet. Then too with the protruding lip the sheet was delivered nearer the pull-out surface to prevent any thinning of the sheet due to its drawing from its own weight. In effect the die lips as shown for thick sheeting increases the land length to offer greater resistance to flow and obtain a uniform thickness even in the .060" sheet.

There is a general guide for the design of die lips. In general, thicker sheeting requires longer lands whereas thin sheeting requires shorter lands. For extruding sheeting in a number of thicknesses the land length and orifice opening should be approximately as follows:

Sheet Thickness	Orifice Opening	Land Length
.010"	.010"	$\frac{3}{8}$"
.020"	.022"	$\frac{3}{8}$"
.030"	.034"	$\frac{3}{4}$"
.040"	.045"	$1\frac{1}{4}$"
.060"	.045"	$2\frac{1}{2}$"

While this rule of orifice design is generally true it cannot be over-looked that with a flat die not nearly so much drafting is done on sheeting from .020 to .060 inches thick as is done using a round die. Therefore it

is often true that the orifice can be .040" opening to extrude a sheet more than .040" thick. In extruding .060" it was found necessary to use a long land and a .045" orifice to obtain the best results. The sheet was not drafted and the back pressure was built up by the wide land to cause the sheet to issue from the orifice and thicken. This extrusion, of course, was done using a flat die. When the orifice was set up normally recommended, about .060" to .065" the back pressure was not sufficient to prevent surging. Had the heating capacity of our extruder been greater to allow a higher rate of extrusion in feet per minute the conditions on .060" sheet might well have been normal.

Variation

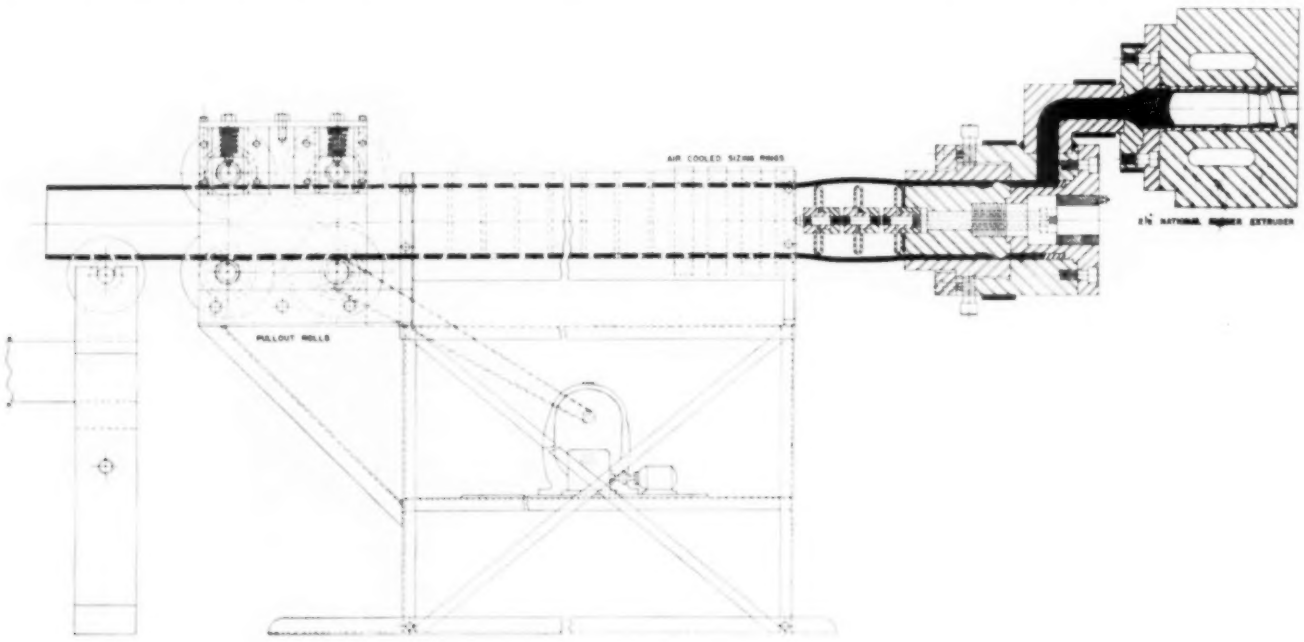
Many questions may arise in your mind about the quality aspects of extruded sheet. Certainly it is not as good in thickness uniformity or as free of imperfections as a sheet made from a solvent roll coating process, but it can be extruded into an attractive uniform product for many sheeting applications. It is my actual experience that .001" sheet can be made with a thickness variation of not more than .00025" crosswise or lengthwise. On medium thickness sheeting of .020" it is possible to run with not more than .002" variation and on .040" to .060" of not more than .003" variation. I state these figures conservatively as those well within reach of a process which is properly designed and operated.

Within the last two years a need has arisen to extrude pipe in sizes of 4" and smaller. The same need to dry the material and to control temperatures applies to the extrusion of pipe as to the extrusion of sheeting. The same type of hopper dryer is used and circulating oil is the heating medium on the extruder. Electrical band, strip or inserted heaters, are used on the die. Notice in the figure below that a torpedo tip is used on the screw. This happens to be the screw in the machine in our laboratory and it could as well be the slotted tip shown on the sheeting extruder. This torpedo serves to restrict the flow and maintain a back pressure on the extruder to minimize any surging. This problem of uniform heating and even flow occurs as a problem which must be met in all extrusions.

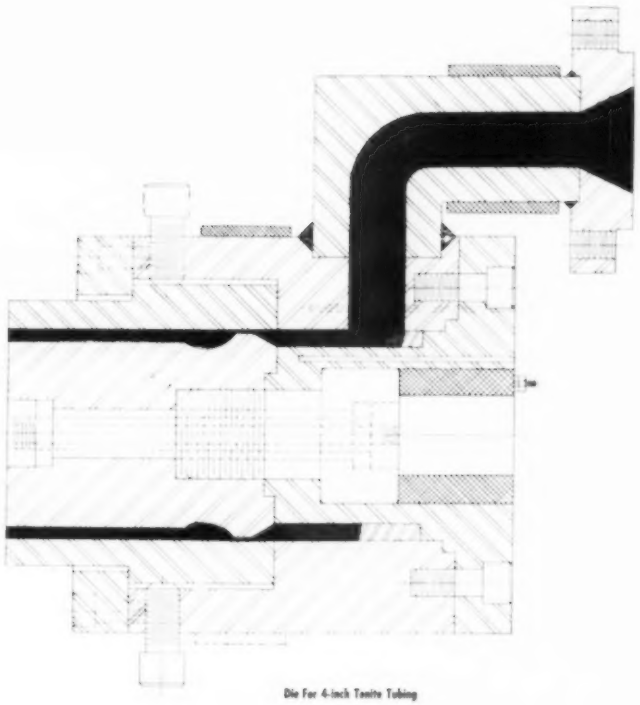
Notice the method of handling the extruded pipe after it issues from the die. When the process was considered there were various schemes possible for cooling the extruded pipe to keep it round until it was self-supporting. A mandrel could have been used over which the pipe would be extruded and cooled with water or air. The pipe might have been extruded directly into water and chilled quickly into shape. However, it was found that the rather simple process shown gave an easier solution and a tougher pipe. The pipe is first cooled only slightly and held in shape by the three inside cooling rings. Air heated to 180 degrees F. and at 20 pounds per sq. in. pressure is supplied by a pipe running through the center of the inside die ring to the three inside cooling rings. This heated air is also supplied to the first outside cooling ring. The three other outside rings are supplied with compressed air at room temperature. This method of cooling has proved that the heavy section is not chilled to set up strains and cause brittleness as might be the case with other methods of cooling. The pipe is supported by the hot compressed air supplied to the inner rings. These rings are made by fastening two plates together spaced in such a manner as to leave an orifice with air escaping over their entire circumference. There are two sets of pull-out rolls spring-loaded which draw the pipe at a uniform rate through the outside cooling rings. With the internal pressure forcing the pipe to fill the outside cooling rings a uniform outside diameter is maintained. The pipe is shown larger just prior to the first outside sizing ring. This is actually the very thing that takes place in the extrusion process. It appears that trouble would be encountered in drawing the swelled pipe through the first ring but such is not the case. The pipe is soft enough to be slightly drafted and sized.

Unique Features

The die has unique features. The die is offset for a purpose. First the inside die rings can be held in place by the center stud which fits in from the back of the die. The outer ring is held by an outer clamping ring. This design allows rings of a wider range of diameters to be used than would be possible using a die fastened directly to the extruder and requiring the die rings to be bolted on from the front face of the die. The offset die permits the introduction of the heated air to the inner cooling rings without running the pipe through the



Equipment for Extruding 4-inch Tenite Tubing



Die For 4-inch Tenite Tubing

path of the plastic material. This pipe is insulated from the die body to prevent the inside of the die from being chilled. This point should not be overlooked in the design for the die would not work at all without this feature.

With this design the same die body can be used to extrude from 2" diameter pipe to 6" diameter pipe. By a second die body pipe can be extruded from the $\frac{1}{2}$" diameter up to 2" diameter. Two die bodies are sufficient to cover a range of pipe $\frac{1}{2}$" diameter to 6" diameter. It is interesting also to note that material flows around the die causing only one weld point.

Restriction

Another unique feature is the restriction in the die which is the same idea shown on the sheeting die previously discussed. It was on this extrusion of a $\frac{1}{4}$" wall pipe that the idea of restriction in dies was discovered. Without such a restriction the pipe wall was filled with bubbles and voids. By the use of the restriction these bubbles were forced out of the material to give a solid uniform pipe well. You will also notice the long land which bears out the general conclusion that was expressed in the extrusion of sheeting that the land must be lengthened as the thickness of the material extruded is increased.

I know that many questions occur to you when considering the merits of this process as compared to other methods. Some have questioned the cost of using such a quantity of compressed air. It does require 100 cu. ft. per min. of free air to cool a 4" I.D. x 4.5" O.D. pipe. This would require the purchase of a $2,000 compressor, but the cost per pound of pipe extruded to operate the installed unit would be not over a quarter of a cent. This element of cost in my opinion is offset by the simplicity of the operation and the assurance of obtaining a pipe relatively free of strains. I have seen very brittle pipe granulated and re-extruded to be very tough, the improvement due to nothing more than technique of extrusion without strains being set up.

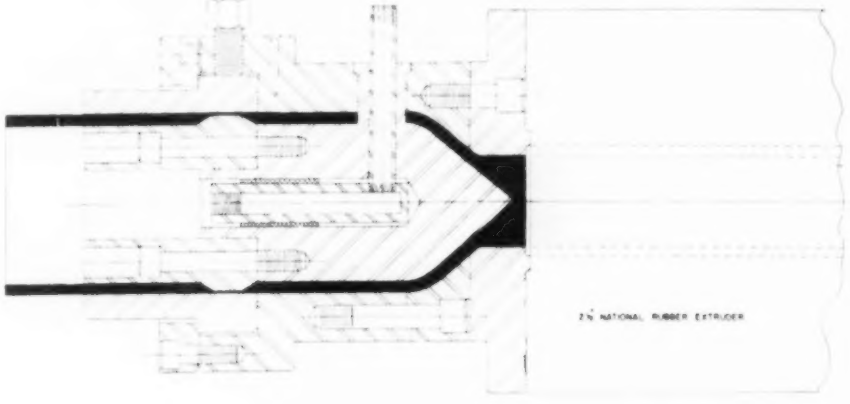
The process as shown, however, is not a cure-all for strain-free pipe and it should be recognized that even with heated air to cause gradual cooling that care must be used to avoid strains. The least amount of air possible to support the pipe and control its dimensions should be used. It is surprising how small details can make such a great difference in the quality of an extruded product. These procedures are something hidden by operators who learn them through experience so it is well to keep a good record of the exact methods by which satisfactory results are obtained.

The question is sometimes asked, "What are the tolerances possible in this process?" While this problem has seldom arisen on installations replacing metal pipe I do know of one case where a 4" pipe was cut into sleeves to fit over a shaft. The tolerance on this job, plus or minus .015", was met without difficulty. A variation of not more than .030" in any direction can be maintained in 4" diameter pipe. Of course in smaller sizes much less variation would be possible.

Data Available

Drawings and detail procedures are available for all the equipment which have been discussed. Those who are interested in such details can obtain them from the Tennessee Eastman Company. I have tried to present the general problems as we recognize them in extruding the best quality sheeting or pipe from cellulose acetate or cellulose acetate butyrate. I am forced to admit that the process of extrusion must to some extent be classed as an art. All factors affecting, particularly the flow, cannot be entirely explained. This I think one must admit about much plastic processing. However, to summarize my points, it is extremely vital to dry the material and to control temperatures at all points in the extrusion. Then, as the final requirement the material must be delivered to the die uniformly heated and at an even rate. I have placed great importance in the proper back pressure by restrictions such as the screw tip, the screen and grid plate, the restriction prior to the die lip and the proper land length on the die lip.

Aside from the extrusion problem it is felt that you would be interested in the bursting pressure of



Die for Extrusion of 4-inch Tenite Tubing

TABLE I

Pipe Size	Outside Dia. In.	Inside Dia. In.	Wall Thickness In.	Bursting Pressure at lbs. sq. in. 77° F.	Bursting Pressure at lbs. sq. in. 158° F.	Recommended Working Pressure at lbs. sq. in. 77° F.	Recommended Working Pressure at lbs. sq. in. 158° F.
½"	.840	.622	.109	1500	1000	150	100
¾"	1.050	.824	.113	1300	800	130	80
1"	1.315	1.049	.133	1250	750	125	75
1¼"	1.660	1.380	.140	1050	625	105	62
1½"	1.900	1.610	.145	950	550	95	55
2"	2.375	2.067	.154	825	500	82	50
2½"	2.875	2.469	.203	875	525	87	52
3"	3.500	3.068	.216	800	450	80	45
3½"	4.000	3.548	.226	725	425	72	42
4"	4.500	4.026	.237	675	400	67	40

Tenite pipe. The formula 205E-MH flow is generally recommended for use in pipe. This material is Tenite II and has an ultra violet light inhibitor incorporated to increase its resistance to light and outdoor exposure. The bursting pressures for pipe extruded from this formula are given in Table I.

A 10:1 safety factor is recommended between bursting pressures and working pressures. This factor should be very conservative to cover all conditions and might be less in many applications. As Tenite pipe is considered for an application, until more experience is gained, it is wise to test samples to observe its performance. This can be the only sure way of determining the applications for which it is best suited. The test data, however, can be used as a guide to judge whether the application is at all practical.

Variegated Strips

For the extrusion of variegated strip we have used two extruders feeding material into one die. One is a 2½" diameter National Rubber extruder used to feed a base material, for an example, a light amber. The other is a 2" extruder used to feed a dark filler. The objective in this process is to produce a variegated pattern comparable to the shell variegations commonly used for spectacle frames.

Using the two extruders a variegated strip was produced but the filler was smeared in diagonal and regular stripes across the width of the strip. Also another difficulty was encountered in that the filler made a black edge on the strip as it fed across from the small extruder into the stream of base.

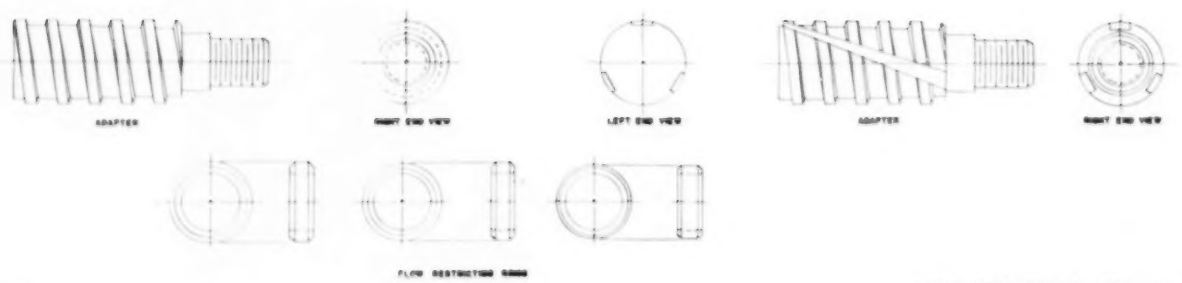
The black stripe was eliminated by putting a liner in the die so that the filler would be carried past the edge of the stream of base material before it extruded from a slot in the liner. The filler then could not blacken the edge of the finished strip but must be smeared into the base material.

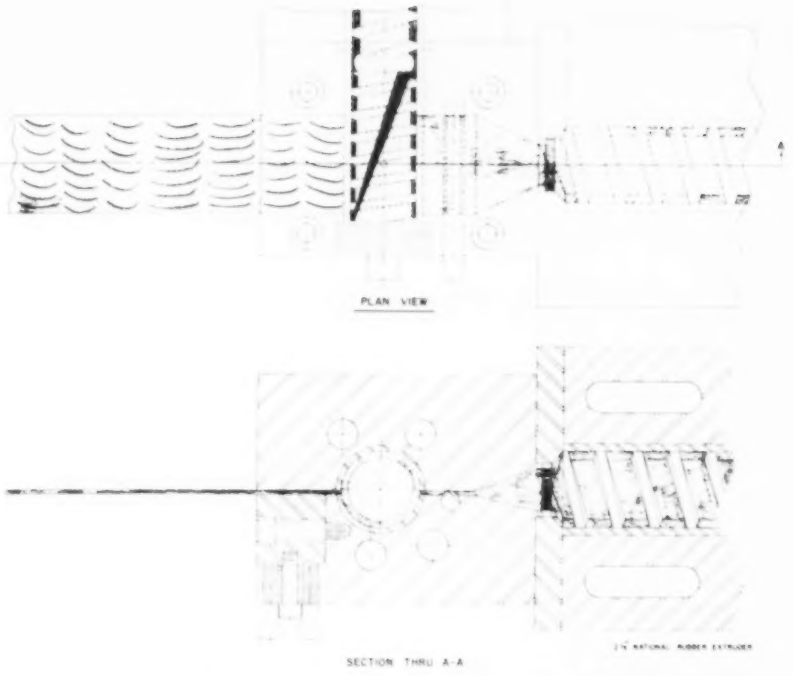
To give a broken pattern of splotches of filler in the base the screw in the filler extruder was cut off and a special tip 4" long was attached. The flights on this tip were slotted as shown in the drawing so that small splotches of filler were delivered into the stream of base material to create a broken pattern. A number of tips were used with the flights slotted in various ways to produce varied effects. The use of tips was only done to avoid producing new screws for each trial.

The pattern can be changed by harder or softer filler, different color of the base or filler, changes in the speed of the screws of either machine. Changes in the ratio of one screw

EXTRUDER SCREW FOR TENITE VARIEGATED STRIP EXTENSION

ASSEMBLY OF SCREW & ADAPTER





EQUIPMENT FOR EXTRUSION OF VARIEGATED TENITE STRIP

speed in relation to the other will change the variegation. However, all of these variations only change the concentration of filler in the base or the number of splotches per inch. To change the orientation of the splotches in the base the flights of the screw tip must be altered.

There is little to explain from an extrusion standpoint about the production of this variegated strip. It is certainly unique to have a process to produce continuously a variegated strip of uniform pattern and one which can be reproduced from one run to the next. Then too, by using this idea it is possible by altered die design to extrude variegated rods. Since much of the variegated sheet material has been produced by batch pressing in the past the development is of interest to those requiring such a product. Certainly the possibilities of producing variegated sheet stock or rods at considerably less expense can be the result of using this extrusion process. Then too by using this general design with alterations to the die it is possible to produce strips or rods of two or more solid colors not smeared into each other. Nothing but variegated strips have actually been produced, however, and these other suggestions are merely mentioned as well within the possibilities of being accomplished with the equipment.

Future Plans

You might be interested in the future plans on the extrusion of cellulose acetate and acetate butyrate. Certainly we will have time to continue to study improved methods of extrusion for sheeting and pipe. One subject which I have not mentioned may well be a part of the program and that is to calendar a sheet to improve its surface. To date much work has been done on calendering a sheet to improve its surface, or to produce a mat finish, without success. The most encouraging results, however, have been obtained by calendering the hot sheet as close to the orifice as possible before it has cooled. Certainly to obtain a surface as good as a cast or rolled coated sheet some method must be found to continuously impart the surface of a roll to the extruded sheet.

Work is being done at present on a process to reinforce pipe to have it withstand greater bursting pressures and thereby broaden the field for which it can be used. The present work is being done using a Fiberglas filament wrap.

The technique of extrusion of cellulose acetate and cellulose acetate butyrate is very practical as an industrial process. Many improvements will surely appear, and we plan to continue our work to that end.

Also, I would call your attention to this fact, that the general method of mechanical and hydraulic extrusion has been practiced for many years. However, none of the apparatus or methods described in the foregoing, or otherwise, should be employed without investigation of the patent situation.

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WHAT SHOULD A PLASTICS ENGINEER KNOW?

Louis F. Rahm

J. H. DuBois

A verbatim report on the education committee forum held at the 8th Annual SPE Technical Conference.

The discussion centers around a course of study proposed by the committee to train Plastics Engineers.

PLASTICS TECHNOLOGY and PLASTICS LABORATORY are included in the undergraduate curriculum for chemists, physicists, mechanical, electrical and chemical engineers.

The graduate program, leading to the degree of M.S. in Engineering, includes the following courses;

Electrical Measurements
Plastics Design
Properties of Plastics
High Polymer Chemistry
Chemical Engineering of High Polymers
Thesis Study

Discussion and comment were on the following questions: Is the plastics engineer properly an educational or an occupational product? Should all plastics engineers have exactly the same educational background? Is graduate training important to the industry? Is undergraduate specialization desirable? Can schools do the job? Is industrial training job training, or does it deal with principles?

Also considered are: What type of job does this program prepare men for? What value Electrical Measurements? What value to industry is a man with this training? Does cooperative training have a place?

Who will teach the teachers?

Rahm—We here are concerned with the educational aspects of the question. In addition to having ideas of what a plastics engineer should know, we may also have an opportunity to explain why the educational filling station never has time to fill the gas tank completely, and in any case, can provide better mileage with the high test stuff at the graduate level.

Mr. Hoffer, your company hires a great variety of Electrical, Mechanical and Chemical Engineers for your plastics division. Do you find that such men continue to identify themselves by their college training, or by the work they do? In other words, should Plastics Engineers be considered an educational or occupational product?

Hoffer—The General Electric Plastics Department has through its experience in the plastics business adopted over a period of time, a policy of hiring approximately 50% of the engineers from school, and about 50% of the men who become engineers are graduates of the apprentice courses, and they, thereby, qualify themselves for Product Engineering activity. Now, as we look ahead, and see the growth of the plastics industry, we feel that this ratio will probably increase to some 80% which we will be hiring from the outside. The engineer which a fabricator of plastics materials is going to hire in the future, we believe, should be considered as an educational product, although this is not the case today. We think that this weakness is one which the course we have outlined here will tend to correct.

A large fabricator of plastics, who is also a member of a tremendous corporation such as we are, has opportunities to participate in training programs which go on within the company, and we are a part of the overall General Electric programs. However, these men, no matter how well trained throughout the company still have to be trained when we get them because our plastics business is totally unlike that of other parts of the GE Company.

Therefore, in answer to your question, I think that we should look to the future for educational products insofar as possible, rather than occupational products.

We have had two of your men from the Princeton Plastics laboratory just recently. These two fellows came to us and we have put them to work in our applications engineering group and they are, literally, educational products because we were immediately able to make good use of their engineering talents.

Rahm—Mr. DuBois, do you think it is possible, or advisable, to turn out plastics engineers all with pre-

E. S. Bloom

R. A. Hoffer

LOUIS F. RAHM received his B.S. degree in mechanical engineering from the University of Michigan in 1921, after which he was employed as a designer for several years by DuPont Viscoloid Company, New Jersey's Picatinny Arsenal, and the Burroughs Company. After teaching at the University of Illinois, he went to Princeton in 1926 where he's been teaching ever since, except for a wartime leave to act as plastics engineering group leader at the National Defense Research Council's High Explosives Laboratory. He has contributed technical articles to various technical journals and is the author of two books, "Plastic Molding" and "Plastics Technology."

J. HARRY DuBOIS, after receiving his B.S. from the University of Minnesota in 1927, was with the plastics department of General Electric Co. He joined the Shaw Insulator Company in 1944 as executive engineer. He recently left his position as manager of new product development for Plax Corp. to take the job of vice-president of Mycalex Corp. The author of several books on plastics, Mr. DuBois was national president of the Society in 1948 and national vice-president in '47. In '48 he was elected to Life Membership in SPE.

J. W. LINDAU III received a degree in Mechanical Engineering from R.P.I. in 1931. Additional postgraduate work was taken at Newark Institute of Technology. At present he is Professor of Mechanical Engineering at the University of Southern California and on the research committee as well as the Graduate School Committee. In addition, Professor Lindau is president of Southern Plastics Company with executive and administrative duties.

E. S. BLOOM earned a B.Sc. in Chemistry from the University of Nebraska in '34, a M.S. the next year, and a Ph.D. in Organic Chemistry from the University of Wisconsin in 1939. After service with the National Aniline Division of Allied Chemical and Dye, Parke, Davis and Company, E. I. duPont de Nemours and Co., he is now Supervisor, Research Division, responsible for technical personnel recruiting and related personnel matters in the Polychemicals Department of that company. He is a member of A.C.S. and A.A.A.S.

R. A. HOFFER is Engineering Manager in the Plastics Dept. of the General Electric Company, responsible for the Industrial Design activities and the engineering related to the development of new markets and new applications for plastics. A 1941 graduate of Purdue with a B.S. degree in chemistry, Mr. Hoffer was formerly with E. I. duPont de Nemours and Co.

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cisely the same preparation, even at the same educational level?

DuBois—It is not advisable, nor is it possible in my opinion, to turn out plastics engineers with precisely the same preparation. The background experience, the personal interest, the capacity of the individual subject, modify the plan acording to his needs, and the SPE program does establish a high level of fundamentals standardization, but to try and make the same type of specific program for each man that enters isn't practical or possible. We are all going to hire our own quota of Electrical Engineers, and of Mechanical Engineers, but we are far better off when those engineers that we hire have these fundamentals of plastics, thoroughly ingrained as part of their training and then with a few of those who will have specialized in the more advanced phases, we'll be able to carry on our business, with less loss and with less training period.

Rahm—Mr. Bloom, it seems reasonable to believe that industry will always need more engineers at the bachelor level than men with graduate training. However, which is the more important to industry?

Bloom—I think that your statement is right that industry will always need more men at the bachelors level than at the graduate level, and to answer specifically your question of which is the more important is difficult, if not impossible. However, it is for the particular job that we expect the various men to perform. It might be said that those who have had the graduate training are performing a task which really is more important for the future of the industry—for the development of the industry, as well. We depend upon them to a large measure, those with graduate training, to come across with the ideas of new things which is of course, not impossible for the man with the bachelors training to do, but he probably will certainly not do it as soon as the man with graduate training and a little broader exposure to some of the fundamental principles that underlie all of the plastics industry. I want to emphasize though that it is still the individual that counts in the long run, as to where he eventually gets in an industry. I think that is probably true in any organization, that it is the individual that counts in the long run, but in the immediate future, his extra training I am sure would stand him in good stead.

Rahm—Mr. Lindau, what do you think about the desirability of specializing engineers in plastics at an undergraduate level?

Lindau—Well, it's about the same as trying to put ice cream in your pie a la mode, under the crust. There is so much under there now that actually is necessary that in order to get the specialist with enough courses in background up to the point where he can specialize in Plastics Engineering, I don't believe our present courses can handle it. Now, I am most emphatic in stating that I don't think our engineering curricula are right now. I think that we lack emphasis on certain subjects at the present time that are just as important to the man as, we'll say, a course in Mechanical Design. He needs more Humanities, he needs more Economics.

As a matter of fact, at lunch today, we were discussing the prime importance of the engineer with his thoughts toward economics. That is where he has to start from. Well, we are going to have to cut something out if we are going to put into it, and as far as I can see, I am most anxious to keep the Plastics Engineer, per se, above the under-graduate level. Let him get his baccalaureate degree. If he finds at that time that he is unable through the inability to get a fellowship or to afford the cost of additional education, why—I am sure that the industry can absorb him in plenty of likely operations, but not as a direct Plastics Engineer.

Rahm—You would believe, however, that the fellow would have benefited by these two introductory courses.

Lindau—Oh, absolutely. Anything that we could add on in other courses. We could take the course in Mechanical Design, for example, and give him a problem in the design of a plastics mold, or give him a problem in the application of a plastics end use,

which he could work all the way through, not only as an engineering problem, but also as a problem in economics. Working it out from this initial level would help him. There's no doubt about it, but he still wouldn't be a Plastics Engineer. He'd be a Mechanical Engineer with a little more sugar on the top, let's say.

Rahm—As various industrial training programs in plastics indicate the need for specialized training beyond the general education which the engineer receives in college, do you think that the schools can do this job as well as industry?

Hoffer—There are various types of on-the-job training programs. I think that industry cannot possibly expect schools to take over the complete task of training of the engineers. Certain aspects of it have to be done on the job, in a specialty line, where the certain industry has special techniques and technological problems confronting it. But, for the general fundamental training, I don't think there is any argument at all, but that it is a job for the schools to do. Industry is dependent upon the schools to do the job for them in the training of basic principles and fundamental concepts in engineering in general, that they can apply without hesitancy, and waste of time, after they get on the job.

I think it would be an important thing for schools to try to develop as much as possible the background and the knowledge in an individual as to how he should tackle a research problem. As it stands, we have to instill that into graduates, frequently; they don't have it yet, so that from my point of view is one aspect that could receive further attention in their school training.

Rahm—From a school teacher's point of view, we feel that we can do the basic principles better and cheaper, and that the industry can do the job specialization better and cheaper.

Hoffer—The schools have to recognize that they are training individuals to go into a wide variety of jobs, so they can't get into the specialty training that is required for these individual jobs, too.

Rahm—We could do that, but we would not be educating in the best interests of the man himself, because he might be more valuable to a particular industry for a particular job, but we have to consider his welfare, as well as industry.

Bloom — This pre-supposes that schools are going to be just as much on the ball as we in the industry have to be—and try to be—in order to be competitive. And, one thing which I think would be absolutely mandatory would be a recognition on the part of the scholastic institutions that it is their responsibility in keeping up with the plastics industry so that they aren't talking techniques, methods, and materials that are passe and out of existence for years past.

Rahm—To what extent are industrial training programs a matter of job specialization and to what extent training and basic principles?

Hoffer—Well, obviously, our training programs have to be ones of job specialization. We in industry have the problem of indoctrinating the engineer with the idea that he is there for a purpose, and that is to make money for the company. He is not now to get further academic training but he is now a member of a corporate structure and has a definite assignment to give that corporation a better cost position, a better market position. So that programs which we have to install are for the purpose of training that man to a particular job as quickly as possible. And in this training, it depends upon the background of the engineer as to what will be required. We have had indications that we can short circuit a certain portion of the fundamental training program and actually train him in the peculiarity of our particular part of the plastics industry. For example, a man coming to us who has a knowledge of compression, injection and extrusion is far better than one who has merely the basic ability to think and has an engineering background. We, then, can apply those particular background data which he has to our problems immediately and have him become valuable to us in a very short time, so we are hopeful that the job specialization aspect of our work will be all that is required. Basic principles will be incorporated in the individuals training by the educational institution.

Rahm—What types of jobs is this program intended to prepare men for?

Dubois — Any scholastic training, engineering training, is primarily to develop the reasoning power of the individual, and secondarily, to give him the useful tools of the trade so that he can move forward more rapidly than the boy who does not have the background to pick up the thing with the same speed. The SPE program amplifies his ability to move on faster in the plastics industry because he has a better understanding of the more or less basic fundamentals, and it will prepare him for the general fundamental jobs, the educational work, the engineering work, and the sales phases of the industry. He is equipped with the basic understanding—with the fundamental tools—he is going to work with in finding his way.

Typical starting jobs as we all recognize are, first of all, the teaching profession. Many of the boys go through that as a secondary stage of the educational program while they make the advanced study and possibly dig into the research work, which is a very fine starting point for the boys who have finished this program. Then they go into development work which is a step beyond research work where the results of research are put into tentative production methods. He can go into the Design Department where he converts the user's need into a product that is salable. From there he might go or start, as a technical salesman with specific training along certain lines where he supplies technical assistance to the field, clearing out some of the troubles and problems at a technical level. And of course technical sales are of increasing importance. Many of us today would not hire a salesman who was not an engineer first because we have found that to a large degree, results are faster, and the economic results pay off more quickly. And, going through all of these stages, of course, the ultimate goal is to arrive in a management position. It is inconceivable that a manager can do a good job of making management decisions unless he has a fundamental understanding of all the elements that go into the operation of the business. Of course, having this basic background of general level and technical education, with the plastics materials, he is able to devote more time to the other studies that are pertinent to the management and operation of the business because he has these many tools as a result of the classroom work.

I know that a lot of these things are rather controversial. There are a lot of people who don't agree that technical men should be used in sales positions. Many other people believe that the educational time in schools is lost. That is, the specialized training is lost because they must learn those specialized requirements on the job and get only the bare fundamentals of mathematics in the colleges.

Lindau—I do feel very strongly that since we do have so small a percentage of men who are technically trained, I believe that they should be in a laboratory, and I think, also, that those men who are developing should certainly reap the same reward as the salesman who is out in the field.

Question from the floor —Seems as though the panel is divided among itself and it brings up a question in my mind—do we really know what a Plastics Engineer is? It seems to me that two of you are talking about one type of an engineer while two are talking about another type of engineer. There certainly is a wide divergence—the one who works in a laboratory and does research work is not one to go out and sell safety

azors from a technical standpoint.

Hoffer—We recognize in our activity that there are engineers which we designate, first of all, as salesmen. The question is how many types of engineers do we recognize here. We are talking about Research Engineer, talking about Sales Engineer—I am saying there are several more.

We have what we call the salesman, the application engineer, who actually goes out and breaks ground for the salesman in developing new applications, new markets. And, we have what is often called the Technical Serviceman. We also have engineers called Product Engineers, who are working on current applications, but doing engineering beyond that which the salesman can give as regards to time. Then, we have engineers who work in the research laboratories, as well as engineers who actually work in the process end of the business. Any of those would be possible jobs for the graduate of the plastics engineering course, as far as I am concerned.

Floor—I think it depends pretty much whether you are speaking from the level of a converter—converters take the raw material and just make them into finished products, or whether we are going to get to the technical end of manufacturing of new materials and new methods. I think the technical end is a very large one, because you don't know where the man is going to go when he takes this course. Now, if he is going to work for an outfit like DuPont, he needs a different knowledge than if he goes to work for a molder. Or, if he is going to become a Product Development Engineer, or a Consultant, or something like that. I mean, it's pretty hard to put your finger on it and say what this man is when a man is training.

Hoffer—The question seems to be, can we put these men into a sales area immediately or are they best fitted and can we make better use of them by putting them in research —and I'm taking the line that with this—an engineering background, plus a specialized training which they receive over and above their 4 years of college, that they are then well qualified to step into the technical service aspects of the business.

Lindau—Bob is also referring to this operation from the standpoint of a fabricator. I think Dr. Rahm could clear up the point most distinctly by stating that actually this plastics course is being developed, not particularly for the materials people, but is being developed for all of us, that is, for materials manufacturers, as well as for the fabricator of those raw materials.

Hoffer—I think of one point here that we overlooked. I think the basic training can be used in any one of these places and that the individual qualifications and characteristics are probably more important than the basic training as to where he would be most effective in an organization, whether it is in research, sales, or where. Maybe you can't say dogmatically that they ought to go into research and then go into sales, or go directly into sales—it depends upon individuals. Some should go into research and stay there—never go into sales—and the other is true, too.

Rahm—I think that the general impression among molders is that there isn't anything in this for them. They haven't found out yet that it would pay off, and of course, the people they would be interested in are not the chemists—they can't use them around the plant. Occasionally they could, as a matter of fact. But the fellows of most interest to them would be the Mechanical Engineer or the Electrical Engineer, either of which could easily break in on production work or design work, or operation.

Hoffer—That is the importance, I think, of the broad general program.

Rahm—What was the purpose of including such a specialized course as Electrical Measurements in this program?

DuBois—The specialized course in Electrical Measurements is an important part of the general training program since all the plastics are valuable insulating materials, and a complete understanding of electrical measurements and insulation values are basic tools used in the selection and evaluation of the plastics materials. Every plastics engineer who will handle general problems must have a complete understanding of the ASTM standards, the methods and the values obtained by these methods. Without a fundamental knowledge of Electrical Measurements, and electrical problems, I don't see how it is possible for a plastics engineer to discuss the general problems intelligently. It is true that there are certain phases of the industry where no electrical measurements are required, but when you are turning out a man with fundamental training who must be able to meet the broad questions of industry, he certainly must have a fundamental understanding of the methods used for testing and evaluating and establishing the standards of values for the materials that we use every day.

Rahm—Wouldn't you think that this was a case of providing training to the better advantage of the man rather than a particular industry?

DuBois—To me it is just so much mathematical training. It's one of those things. If he could say, I am going into the toy business and never going to make anything but toys then he might by-pass Electrical Measurements. But, he doesn't. Business will get bad in the toy industry and the toy-maker will be soliciting telephone hand sets or electronics parts and then he has to go out and talk to people to do the engineering on their problems with a fundamental understanding of their language, and he couldn't do it with just the knowledge of plastics. He has to talk the user's language, and he has to talk intelligently with material suppliers and he just can't be handicapped by the lack of something which is as fundamental to insulating material as Electrical Measurements.

Lindau—I disagree that a specialized course such as this is necessary but I believe that an appreciation of Electrical Measurements should be included in your course, say, on properties of plastics and the means by which those properties are measured. I'm thus in disagreement with this as a special course in the over-all plastics education relating to this program.

You might be anxious to know what the practical results of this has been among boys we have trained so far. The Electrical Engineers who have gone through this program have never, by any remote stretch of the imagination, used their electrical training, either undergraduate training or training that they got here. Several of the chemists we have had go through the program, "beefed" about having to take electrical courses for four terms. They are the ones who are not only using it, but they had to dig into electrical properties and electrical measurements and go even further than we had carried them. So, you never know what job you are training them for.

However, it does remain that we of the plastics industry are going to be subsidizing one way or another this over-all program with the educational institutions and it does, therefore, devolve upon us to get the best courses set up for the people that we are going to ultimately hire and use in this business. Thinking along those lines, it seems that each one of us has ideas that are worth discussing or worth thinking of. But so far, the best plan is the one that has been brought up by Louis Rahm and is up on the board.

Lindau—Anybody can go to a handbook and obtain information on specific properties but it doesn't make a man that particular type of engineer, any more than reading the data sheet in our Plastics Encyclopedia makes him capable of even applying the most rudimentary types of ingenuity to the application of a plastics material for an end use. He has to know the variables that occur in that material; he has to have had either the experience which he can obtain in your plants, or that which can be given to him in a laboratory

where he takes the materials and runs them through a series of tests and actually knows that even though this particular material may have an impact strength of .035 foot pounds per inch of notch that's just double talk unless he knows what that impact is going to be on this particular end use. The plastics engineer who is able to read a data sheet and has had no experience with the particular material, certainly is not capable of applying that material to an end use.

Rahm—Can a course in component and equipment design be expected to provide any more than basic design priciples?

DuBois—Again, the fundamentals are the tools with which he works. The course in Component and Equipment Design will have done well to accomplish an understanding of the basic design principles. The hemstitching and the polish are going to be achieved out in the field and they will come by experience and association with contemporary practice. All engineers work with the fundamentals of materials and mechanics to develop answers to current assignments and the quality of their performance measures their value to the industry. I think there is nothing that is worse to industry than to have its experience become in-grown. The younger engineers are totally unprejudiced and uninhibited by experience in the things that we tried, and failed, and they will go ahead and do things that we tried and failed, and never tried again. That is where they are going to use these fundamentals and come up with answers to things we overlooked. You can't expect them to have the final answers but you can expect them to get the fundamentals so that they can work out the problems that we assign to them. In many cases they are going to come up with new approaches and that is what this industry needs.

Rahm—One of the things I had in mind is what every molder would think of immediately: Could one of these educational products we are turning out be expected to be a finished mold designer upon arriving at the plant and going to work.

DuBois—I'd be surprsied if he did, but I would say that he could be expected to "sweat" one out that would work and he might surprise you with the original thinking therein.

Rahm—Can chemists and physicists with this added training find special opportunity in industry?

Bloom—It seems to me that with the rapid expansion in the plastics field there can be no doubt but that there is going to be tremendous opportunity for those who have the special training and the added training as such a program as this will give.

We have in our own group a couple of men who have taken this course, and it has been recognized by those working with them that they certainly have been able to go ahead with a research job much more quickly and with much less wasted time.

Question from floor—Is the program intended primarily for molding, fibers, or sheeting material? Is it for any one special branch or is it general?

Rahm—It is general training in the special field of plastics.

Comment from floor—This program would never hurt anybody because up to this time the industry has been supplying its own training for its own men or the men it wants. If it just does one thing, that is, if it gets people on their feet to the point that they want to go out and find new applications for plastics, that would certainly help.

Rahm—I think it also relates to the question, "where does industry now buy its engineers?" Do they grow their own, or do they go out into the public market place, namely their own fellow-competitors and buy their engineers? If that is the case, should we not provide a better source for the needs of the industry? As it grows larger and larger, we can't be trading men back and forth, we have to have them fed in from the bottom, capable of doing a job from the start.

Lindau—We want to get engineers from the most economical source. We don't want to have to pirate them and we don't want to have to train them in our own plants. What's the other way of doing it—the cheapest way. The way which you know you can get a fairly uniform product to start that will fit into your particular business with a ground work for actually earning money the day he gets in there.

Rahm—Do you think that there is a place for cooperative training in this type of program?

Lindau—I would think that would be the best type of training for any designer who would be able to go into a specific industry or a specific company directly after graduation. The first two years of training should be in basic fundamentals, and humanities. I want to emphasize the fact that the engineer needs the humanities just as badly as the B. A. During those first two years while he is getting his fundamentals in chemistry, physics and mathematics, he should not interrupt his training. Then, after that sophomore year has been completed, a course laid out so that he would be six months in the field and six months back in school, would be an ideal way for that young man to be trained, not only in a specific industry but in a specific organization. During that time he would not be a total loss to your organization, he would be capable after 3 years of work of fitting into a job that would cost you money in hiring an engineer who had no plastics background at all.

Question from the floor—It seems to me that the engineer can get his specialized plastics training either in college or industry. Can the college give him the specialized training faster than industry would, or vice versa?

Hoffer—Experience has shown that with us, when a college gave him the specialized instruction, we could use him immediately.

Lindau—There we come again to the fundamental use of the engineer and the basic economics, and one thing I think that is noteworthy is the fact that if a man is going to be trained in industry, he will be trained in that particular industry, company or corporation, and in their basic methods and policies. He will not be fitted to go out into the plastics industry itself, and be acceptable to the X company as well as to the GE, Southern Plastics, or any one of the other organizations.

Question from the floor—How many institutions or colleges would have these programs? And these men who teach these courses, where do they come from?

Rahm—Precisely why I am here. What we want to know, and what we want to get out of this this afternoon, is, do you like this program? Is it good? If it is, what can we do to develop these courses in various schools? How many of these engineers could the industry absorb per year?

From the floor—Say, for example we do arrive at a figure of the number of men who could be used in a year in an expanding industry such as plastics. The end product is only as good as its maker, and these men who are going to teach Chemical Engineering, or Properties of Plastics, Mold Design, or Electrical Measuring, or other courses that are up on the board, where do they come from and will they be competent enough to make a product that we want?

Rahm—At Princeton we had to train these teachers ourselves. We were hoping that other institutions would get interested and start similar programs. Some of our first product might go out to help other schools set up such courses. There hasn't been any demand as yet, and one of the things we want to find out this afternoon is, how can you encourage the establishment of curricula like this in various schools? What you get out will depend on the scholastic standing of that particular institution.

We can supply beginners for others

if they are interested in starting.

DuBois — The question over-looks the fact that Lindau is running a plastics company and teaching school both at the same time.

Lindau — I wouldn't say that was exceptional. Actually my interest in the plastics industry has encouraged me to interest the board of trustees in a graduate plastics course. We want to be an assistant to the industry, and we don't think that one institution can turn out all the men who are going to be needed in that field. However, it is up to you to decide whether this program is right, whether these things that we have been bringing up at this time, are actually the requirements for plastics engineers. I can assure you that if there is any indication of enthusiasm on your part that the University of South Carolina will most certainly enter into that field.

Floor—That is one part of this discussion that I didn't quite understand. That this was all going to be done at two universities; I thought that the program was going to be expanded throughout the whole country.

Lindau—I was talking personally, as a one individual on this program. You are all connected with institutions of higher learning. You all can inspire those places to know of the need for additional man power.

Rahm—It is obviously an educational opportunity for a good many schools, provided you think this is a good thing and you indicate your desire to have men so trained.

Floor—Exactly. That is a fine thing to have, and if the industry needs them that badly, and other schools are needed, I thought that at the same time that industry should offer some of its men who want to help the quota along by helping develop their end product.

Rahm—What can industry do to encourage the development of such programs in colleges?

DuBois—First of all it's up to all of us to alert our own schools, ones with which we have contact, to the needs of the industry as we see them, and keep them in touch with the demand, because no college wants to turn out men who are not wanted, and they all want to try and meet the demands for industry, so we must maintain those contacts. SPE must direct the engineering educational activity throught the country. A couple of minor ways industry can help—it can establish fellowships and scholarships that will permit students to make advanced study on the broad, general requirements of the industry. The industry can also provide vacation employment for both the teachers and the students so that they can obtain industrial orientation to keep the work in line with contemporary thinking in the schools. But of largest importance is for SPE, and all of us as individuals, to keep the contacts in our own schools and our own educational institutions where we can keep them in line with the needs of industry.

WEST NEW ENGLAND KEEPS UP TO DATE

By Edward J. Sweeney

The monthly dinner meeting of the Western New England Section was held on March 5.

The program consisted of a Symposium on Preplasticizing.

Mr. George Whitehead, of the Improved Paper Machinery Corporation, discussed Preplasticizing from the machinery angle; Mr. Sanford Glick, of the Monsanto Chemical Company, gave the materials supplier's viewpoint; and Mr. Sherwood Young, of C. F. Church Company, covered the subject from the molder's angle.

As usual, there was not complete agreement on the relative merits of Preplasticizing from the three viewpoints. There was enough basic disagreement to provide a very interesting discussion period with the members of the audience taking an active part.

February 6 meeting

President John W. Mallory presented the proposed 1952 monthly meeting program. Ed Childs, program chairman, has prepared a schedule of interesting and informative meetings.

Sherwood Young, National Director, reported favorably on the Chicago Conference, and indicated that New England should try to prepare as interesting a program for 1953 at Boston.

Dr. Reed Fordyce, product development manager of Monsanto Chemical Company at Springfield, presented a motion picture on Krilium, with a discussion period following. Krilium is the new soil conditioner Monsanto has under development.

Dr. Fordyce pointed out the advantages this development could have on the overall plastics raw material program. The subject was of special interest to the amateur gardeners in the group.

Dr. Colby, of the University of Massachusetts, was a guest.

The section plans to invite faculty members of various colleges to each technical meeting.

UNITED AIRLINES IS GOLDEN GATE HOST

By V. C. Rollins

Thursday, February 28, the Golden Gate Section of the Society of Plastic Engineers were entertained by the United Airlines Maintenance Base at their South San Francisco location. Mr. William Hecht, Public Relations Director, and Mr. R. Koza, Engineer, were co-hosts to the members of our group.

A splendid meal was served after which Mr. Koza presented the airlines' views on plastics; pointing out that all airline companies were most receptive towards the use of plastics, particularly due to their durability and lightness. After which a conducted tour through the giant maintenance base of the United Airlines was conducted by Mr. William Hecht, Public Relations Director, in which he explained to the interested group the various operations including engine repair, wing fuselage assembly, instrument repair and many other phases of their operations that are necessary to keep their aircraft in operation.

We were then privileged to see the large repair docks which are fitted out for each type of plane to be serviced so that workmen may be able to enjoy easy accessibility to all the plane's surfaces. Mr. Hecht explained that after a certain required number of hours in the air the airplanes are very thoroughly serviced with such a minute inspection that no bolt or rivet escapes their scrutiny.

This maintenance base is the only one for the United Airlines and serves all its aircraft including the Boeing Stratocrusiers which travel to the Hawaiian Islands and back.

Each question asked by the members was thoroughly answered and the members are greatly indebted to the United Airlines for an extremely interesting visit to that installation.

CLEVELAND MEETS

By S. S. Caldwell

A very interesting meeting was held at the Spanish Tavern for the Cleveland-Akron Section of SPE on February 25, 1952. We had the pleasure of hearing Mr. E. M. Hayden of the Stanley Chemical Company who gave a talk on Slush Molding of Vinyl Plastisols. Mr. Hayden's talk was very complete and interesting and he showed a wide variety of products and examples of slush molding. A lively question and answer period followed his talk. The Cleveland-Akron Section enjoyed a very interesting and informative evening.

Dailey Promoted

Promotion of **Robert G. Dailey** to Sales Manager of The Reid Division of The Standard Products Company, with headquarters in Cleveland, was announced today by Harry D. Myers, President.

Prior to his new appointment, Mr. Dailey was an account executive in the company's Sales Office in Detroit.

Fig. 1 PROPORTION is the relationship between areas or parts. This automatic coffee percolator has excellent proportions—notice the pleasant proportion between the round glass top and the roundness of the percolator and even more important, the diameter-height relation. Both the molded handle and the spout have been well styled functionally and decoratively. Their size and shape are closely tied in with the main body.

Fig. 2 BALANCE (formal) is the quality of equilibrium or stability which suggests repose or rest and results when there is an equal distribution of parts on either side of an axis or centerline. In certain designs, function will determine whether or not a design will have a formal or informal balance. Formal balance suggests dignity and formality such as this console radio.

Fig. 3 BALANCE (informal) gives movement to the design. Industrial designers lean heavily on informal balance in product design. The table model radio is an example of informal balance. Notice that the designer has judiciously placed the three knobs and dial closer to one side without throwing the overall design out of balance.

PRINCIPLES IN PRODUCT DESIGNING

Fig. 6 HARMONY is made up of proportion, balance, rhythm. It is the complete agreement between all parts of a design. Too much harmony can be monotonous but the designer can relieve this by injecting variety into the design. This well proportioned waffle iron has good formal balance and the lines on top provide pleasing rhythm across to the point of emphasis—the trade name. The molded handles are in good proportion with the overall size of the iron. The designer added rhythm with single lines where the two halves of the iron come together.

Fig. 7 VARIETY is justifiable when it adds interest to the appearance of an object, but it should not be allowed to assert itself too prominently. In this toaster, the designer has broken up the smooth surface by a phenolic molded ribbed base. Devices applied to a product should be so planned that they will appear to strengthen rather than weaken its appearance.

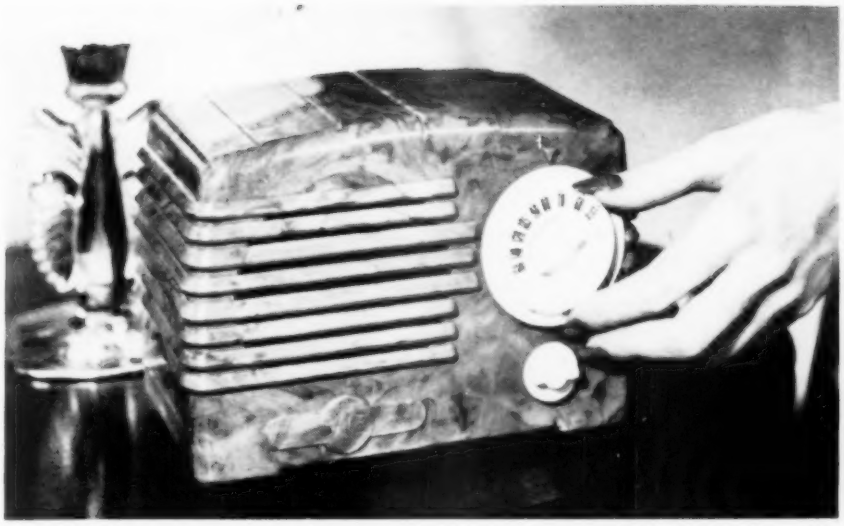

Fig. 4 RHYTHM or "flow" controls the movement of the eyes in design. The use of lines is the simplest way in attaining flow. Rhythm is expressed nicely in this radio with the louvres moving from one side to the other. Lines may appear as grooves, beads, reeds, louvres, bars or merely painted lines. In machining the cavity of a mold, this is generally not a difficult operation.

Fig. 5 EMPHASIS is the center of interest in a design. It may be called the focal point. This well styled electric shaver has the nameplate as the center of interest. If a part is so designed that the eye fails to find the focal point, or there is a scattered effect as when different parts seem to compete for attention, this indicates lack of emphasis.

What goes into the making of a good product design? The answer is a judicious combination of the basic design principles; PROPORTION, BALANCE, RHYTHM, EMPHASIS, HARMONY, VARIETY, TEXTURE, AND COLOR. Shown here are examples that illustrate successful attempts at utilizing these principles in molded plastic products.

Don Biklen

Product Engineer

Orangeburg Mfg. Co.

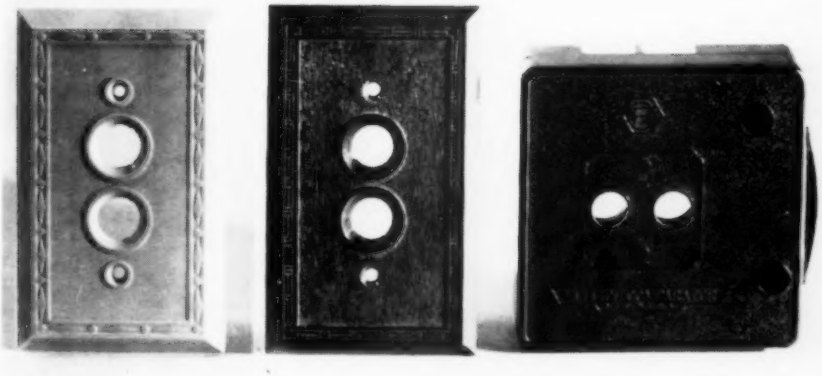

Fig. 8 TEXTURE refers to the apparent surface of an object. Many types of surfaces can be incorporated in the mold cavities to give eye-appealing results on the molded part. Fine knurls, satin or frost finishes, leather grain finishes are a few of the types that are used today. Initial mold costs are higher with these types of textures, but the advantages gained in the design may offset this additional investment. This illustration shows three types of textures that are effective.

Fig. 9 COLOR can be used to advantage in plastics and can bring out or strengthen a design. Combination of colors and or clear plastics creates unusual effects. Color may also be incorporated to produce emotional effects—red, aggressive and exciting; green, refreshing and restful; purple, mystery and depth; white, purity. This white molded scale is very appropriate for butcher shops or grocery stores since it conveys cleanliness.

The Injection MOLDERSCOPE

By A. R. MORSE

President, Injection Molder's Supply Co.

1952 SPE Technical Conference

There were several papers given at the 1952 Technical Conference which were of especial interest to injection molders.

There were two papers given on molding heavy sections. The first paper outlined how preplastifying attachments produced parts which were lighter in weight and more strain free than conventional moldings. The second paper outlined how the same results could be obtained in present equipment by eliminating the conventional proportional feeding devices and substituting weighed-starved feed, and using a ball check nozzle. Every injection molder is concerned with and about preplastifying. Certainly on very large machines and on very large shots, say over 60 oz. as a point of departure, there can be little argument about its value and its place. But in machines under 60 oz. there is a great deal of controversy as to the value of preplastifying in relation to the problems of contamination, equipment cost, maintenance cost, etc. Since it was proven quite conclusively at the last technical conference in the two papers under discussion that conventional machines equipped with a weighed-starved feed and ball check nozzles can duplicate all the advantages claimed for preplastifying, the injection molder who has been contemplating with uncertainty the need for installing costly preplastifying attachments can take heart. His machines are not going to be made obsolete overnight. We are going to have a great deal to say in coming months about weighed-starved feed, bottoming the plunger, and improvements forthcoming in heater design. I would hazard the opinion that in five years time you are going to see weighed feed become standard equipment on every new injection machine.

Now that the scales have fallen from our eyes, it is difficult to see how we molded any good parts at all with a cushion of material ahead of the plunger, and with the plunger exerting a different effect on the molded part every time the compensating feeder varied the cushion. In looking back over the past 2-3 years, I can see this discovery being made, first in one plant and then in another —that something was drastically wrong with the idea of compensated feeding devices. Mechanical troubles with the feeders we tended to think —but it was not that at all. It was a far deeper reaching thing, cropping up in the form of pieces from the same mold ranging from say .090 to .125 in thickness and our not being able to reason exactly why. Now and then, with everything in balance, some molder would produce parts of consistent section—but it has been a struggle. I think therefore that the paper on starved-weighed feed at the recent conference is going to prove one of the most far-reaching in its effects of any paper on the injection process to date.

Another paper covered injection mold lubricants and was briefly given by the writer in an hurried summary on a program running overtime. There are many substances useful for parting pieces from the injection mold, but most of them mark the parts so released so badly that the use of these materials as lubricants is impossible in injection work. Piece sticking is also related closely to process factors, particularly plunger forward time. It is also closely related to mold polish, and few molds receive enough real polishing. We finally developed a silicone type of mold release in an aerosol dispenser that produced the maximum number of good parts possible with minimum marking. We found that stearate was good as a release, but that it did not cause a slick to form on the die as readily as the silicone. This paper is the first one ever presented on this topic, and sums up our experience with various releases and parting agents to the present time.

"Product Design And the Buyer" Is Connecticut Topic

David Mersey

Connecticut's February meeting took place on the eighth at Bridgeport.

The guest speaker, Mr. L. R. Davey of the Greist Manufacturing Company, New Haven, talked on, "Products Design and the Buyer." He came well supplied with a collection of molded parts, from small screw drivers and templates to his company's large, industrial, prize winning polyethylene hinged box.

He said that the buyers of molded parts looked to the molders as the experts of the plastics industry. They are expected to supply a complete service, of design, engineering, and production of simple and complex parts. The greatest advantage in using a plastic part is in the economy of production costs. Any economies in production accrue to the benefit of labor. The plastic part is delivered all finished, whereas metal parts might have to go through further operations before they reach the same level of completeness. A further advantage in the use of plastic, is that of color. The solid color of plastic eliminates the operations of dipping or spraying which go with metal parts. Plastics can be used as replacements for metals, when they are as good as or better than the parts they replace.

From the point of view of design, the solid color of plastic parts adds more eye appeal and therefor overcomes many of the obstacles of merchandising.

The multitude of possible colors is also an aid in production; where many small parts are to be assembled by hand, the various colors are a means of easy visual identification. The use of color is also a means of reducing the numbers of small parts being actually lost. The elimination of sharp edges and angles also leads to short-cuts in production. In using plastics, there may also be savings in freight; in packing time; and also a lowering in the amount of breaking in transit. This last item alone helps eliminate returns and replacements.

During the present period of uncertainty and shortage of metals, there are many applications for plastics as permanent replacements for metals. As a part of a good service, the molder must prescribe the correct material for each application; this applies whether the end product is metal or plastic.

Mr. Davey suggested that, in selling a custom service to a potential customer, it is best for the sales representative to familiarize himself with the customers' products before soliciting any actual orders. In preparing a bid, some of the items to be covered are: type of material, number of cavities to be used, production rate, anticipated rejects by the molder and the customer, price, any anticipated changes due to other materials or alterations in the tools. Some of the factors considered, in placing an order with a molder, are: his financial status, his experience and integrity, the skill of his personnel, production facilities—location of the plant and its equipment, tools—is he equipped to make and or repair them.

As a final admonition, education to the use of plastics is the avenue to an enormous potential market.

Mr. Walter L. Erley of 18350 Kedzie Street, Homewood, Illinois is now a member of Rogers Corporation and will cover our Chicago sales territory. Rogers fabricates unique fibrous and plastics materials.

MOLECULAR ENGINEERING

G. F. D'Alelio

Vice President and Manager of Research Department

Koppers Co., Inc.

Then and Now

It is indeed an honor to address your Society which probably more than any other related technical group is entrusted with the destiny and future of the Plastics Industry of this country. In the United States the term, plastics, has become associated with one of its most important industries, yet this was an industry of such modest birth, that during its infancy, it was questionable whether or not it would survive and mature. In 1920, this industry produced and sold about five (5) million pounds of products, which in 1941 under the impact of total war expanded to 500 million pounds, reaching a billion pounds in 1947, and almost two billion pounds in 1951. From a shellac substitute in the early days of Dr. Baekeland, plastics have become an integral part of our way of living in its necessities and luxuries, in peace or war.

Progress

There are many of us here today who recall the public's attitude of twenty years ago that plastics, trinkets, and gadgets were synonomous. To them plastics were the nebulous and illusive products that appeared as powder boxes and shoe horns, or the impractical or non-durable accessories for the kitchen. Some of the initial failures of these products convinced the layman that plastics were merely a substitute and that the products he bought and used were made from one and the same material, and that all plastics were identical. This conviction was strengthened by the early feature and publicity articles which told the public that plastics men could build airplanes from sea weed, cars from soya beans, or destine the life of an individual from cradle to grave with plastics made from coal, air, and water—all the while neglecting the fact that plastics manufacture is part of a precise chemical industry.

As we scrutinize this industry today, one fact becomes obvious—that plastics have journeyed far in the right direction from the gimcrack era of a few years ago. This outstanding success is written in terms of "engineering" in the fullest meaning of this word. Originally, engineering meant the art of managing engines—but, as the industrial revolution progressed through its many phases, engineering has come to mean the science by which the properties of matter and the source of power in nature are made useful to man in structures, machines, and manufactured products.

G. F. D'Alelio

Engineering dominates every phase of a plastic. It starts with the experiments in test tubes, where the research chemist, who is an engineer working on a molecular scale, utilizes the properties of materials, known as monomers, to synthesize products of certain definite properties, which would be useful as plastics. This engineering extends through the manufacture of these plastics, encompassing in its final stage, the fabrication into useful products, whose utility is limited by the properties of that specific plastic. The link to the success of this industry resides in the calibre of the engineering applied in this last stage. In engineering and construction the product must be designed to fulfill the requirements of the application as based on the properties of the material used, with due consideration given to the limitations inherent in the material. The success of every preceding step is without value, if the properties of these plastics are unknown, ignored, or misapplied in their end-uses.

The initial industrial growth of plastics was retarded to a considerable degree by the lack of understanding of the fundamental properties of these materials. Outstanding improvements in the properties of plastics, or a thorough understanding of their ultimate properties, was not possible until the fundamental and basic knowledge concerning the structure and constitution of plastics compositions was attained. Historically, it required almost one century to acquire this basic information, and though the history of the world is divided into a number of eras, it would be difficult to select the birth date of the plastics era. Historians record the span of time between 1200 and 1500 A.D. as the age of discovery. This, of course, was the age of geographical discovery, and it was not until 1760 that inventive thinking turned to problems of a mechanical nature, setting off the industrial revolution in England. These discoveries materialized in inventions concerned primarily with spinning and weaving. Hargraves invented the automatic spindle in 1766. Arkright discovered a method of drawing fine thread in 1769; in that same year Watts used his newly invented steam engine to drive looms, and in 1785 Cartwright perfected the automatic weaver.

Age of Invention

The impetus of these engineering achievements carried into the nineteenth century. Early in the eighteen hundreds the first railway was established; the housewife used a sewing machine in 1845; Remington introduced his first typewriter in 1873; Bell patented his telephone in 1876; Edison listened to his first phonograph in 1877; and Ford rode his mechanical horse in 1896.

At the end of the nineteenth century the latest products of science were still being made of materials which were known to man in the remote past. The common metals were brought into use between the dawn of civilization and the days of Rome and Greece. It is believed that glass was invented about 1500 B.C. The caveman fashioned wood, pottery, and textiles into instruments of survival before the dawn of history. When one considers to what extent the designs and functions of an object are determined by the materials used in its

construction, it is surprising to find the meager amount of talent that was expended on such promising materials as plastics. It remained for the curious within our own lifetime in the twentieth century to explore and exploit polystyrene as a plastic, although styrene monomer was discovered by Benastre in 1831, and converted into a plastic in 1839 by Simon. This is not an isolated case, since Regnault prepared and polymerized vinyl chloride and vinylidene chloride in 1839. In 1840, Goodyear discovered the vulcanization of rubber.

As late as 1910, the materials of the old world were still the materials of the new world. The only new important materials discovered and used before 1910 were a new metal, aluminum, and the first plastics compositions, celluloid and vulcanized rubber. There are two reasons that explain this situation. First, the studies of Benastre, Simon, and Regnault, to be followed by the extraordinary investigations of many noted scientists, were scientific research in every sense of the word. These scientists were not simply observers, their active and penetrating minds grasped the experimental evidence relative to their subject and they organized it into coherent scientific theories. In their time, it seemed sufficient in scientific work to satisfy one's natural curiosity and the problem ended as a contribution to the sum total of human knowledge. These men did not consider it necessary to apply this knowledge to the material benefit of mankind.

Environment

In contrast to this, we, in our contemporary world, have fostered broader objectives for the role of science. The general public has been so impressed by the technological miracles of science that now they expect science to guarantee the immortality of our type of civilization. Both the cautious specialist and the thoughtful layman see very clearly that if the tremendous structure of scientific knowledge is to be used for man's well-being, it is necessary to focus it somehow on man himself in the struggle for the domination of his environment, which since creation has been man's most important material task. Dr. Midgley very aptly expressed this thought in the words: "We are the only species of living creatures that even conceives of exerting any control over the environment thrust upon it." All the other species adapt themselves to the various influences thrust upon them by an unfriendly and changing world. Man survived his struggle by doing the obvious, he adapted himself to the favorable elements of his environment and improved those factors which contributed unfavorably to his environmental existence.

In early history, he cleared lands for agriculture. He changed the nature of many wild plants to make easier his labors in providing himself with food. He made dogs, cattle, chickens, and pigs into his vassal creatures. He adopted and modified the products of nature to satisfy his requirements for shelter, clothing, fuel, and luxuries.

Even though plastics had been known for many years, man had not, as late as 1910, encountered circumstances serious enough which would compel him to utilize plastics in his struggle for survival or domination of environment. Unappreciative of their potential applications, he relegated them to a position of minor importance.

Theoretical Basis

The meager amount of basic and fundamental information then available certainly would have limited their growth and application. The basic information was yet to be obtained, and it was supplied, ironically, by the devotee of pure science. In their quest for knowledge these early men of science in the 19th and 20th centuries found many complex substances which did not behave in a simple fashion as did ordinary molecules such as water, alcohol, or sugar. The behavior of these complex substances presented serious difficulties of classification and understanding. All the more vexing was the fact that these complex substances were important. They were the natural substances associated with living entities, and they had a direct bearing on life itself. Rubber, silk, cotton, wood, wool, hair, the muscle tissue, tendons, and many other substances fell in this category. The lifetimes of such men as Fisher, Staudinger, and a host of outstanding and brilliant scientists were devoted to this problem. Their researches proved conclusively that the molecules of these materials were much longer than simple molecules—500, 1,000, 15,000 times the size of a water molecule. Some of them were one millionth of an inch in length, others were as long as one hundred thousandths of an inch in length. They told us that they were narrow as well as long, and that in molecular structure they looked like pieces of thread, and that they were really chain-like threads of molecules. They termed these very special molecules "polymers." The name, polymer, has considerable significance. "Poly" means many, and "mer" means unit, so that there are many, many units repeated in polymers, just as there are in the links of a long chain.

Ubiquitous Poly

In studying these natural polymers, these scientists became involved with a class of organic materials which was playing a vital role in man's domination of his environment. Wood, bamboo, and straw, all cellulosic polymers, have been used by man in the construction of shelter for himself and his domestic animals, not only as a protection against the weather, but also against his various enemies, including other men. All of man's clothing is derived from polymers. Silk, cotton, wool, flax, and ramie are synonomous with man. The polymers of coal and wood are still man's basic fuel along with oil, which found its origin in the polymers of once living fish, animals, and plants.

As technology developed in the 19th and 20th centuries, the close association of these natural polymers with life and with living processes became firmly established. In their unlimited and diverse biological functions, polymers defy description as to their importance in living entities. They are an essential of life in the vegetative and animal kingdoms, from the lowest single-celled plant upward to man himself. The cell wall of the lowest form of plant life, the alga, contains the polymer, cellulose. As the plants become more complex, such as bushes and trees, another polymer, lignocellulose, appears, and it functions as the connective substance for the plant. A number of various biological functions of the plant are carried on by various polymers such as the pectins and the gums. Chlorophyll, the green coloring matter in plants, which is an essential in plant life, exists by association with polymers.

The Proteins

The polymers known as proteins are identified with all animal tissues. Our muscle tissue has four protein polymers. The principal constituent of the connective tissue in muscle as well as of the tendons consists of collogen fibers, which are polymers. The protective elements of animals, namely, hair, wool, horn, and nails, contain keratin as their principal polymer. The moth, Bombyx mori, protects itself with a cocoon of tough polymer, namely, silk. Hemoglobin, the coloring matter in the red blood corpuscles of vertebrates, is a polymer. The coagulation of blood depends on the polymer, fibrinogen, which is dissolved in the blood. Many animals store glycogen, which is a polymer, for reserve energy.

Once animal life exists, a large number of polymers play direct and important roles in the continued existence relative to health and disease. The polymers of one form of life may mean death to another form. Rattlesnake venom, crotoxin, is highly toxic to man, and it is a polymer. A number of plant proteins, such as ricin and crotin, are toxins inducing precipitation of red blood corpuscles. Such polymers are excellent arrow poisons. The bacterial toxins, which have been isolated from the tubercle bacilli, are polymers. There are a large number of infectious diseases, which are due to pathogenic units known as viruses. Many viruses are polymers. The enzymes, which are considered as catalysts in the processes involving living organisms, are poly-

mers. Some of the better known enzymes are urease, trypsin, and pepsin. The lactation hormone, which has been isolated from the anterior lobe of the pituitary, is also a polymer. The active protein of the thyroid gland is a polymer. Some polymers exhibit the properties of hormones and are known as proteohormones. Insulin is one of the proteohormones.

Polymers and Life

These are some of the many bearings that polymers have on the existence and continuance of life. Once existence becomes a reality, the struggle for existence begins concurrently with existence. All living entities must have energy for continued existence. The ultimate material source of energy in life appears to be the sun, and the sun transfers this energy to the lowest scale of life by means of polymers. Carbon dioxide and water, under activation energy of the sun and in the presence of chlorophyll, are transformed to starch and cellulose, both polymers. In many cases, there occurs simultaneously with this transformation, the fixing of nitrogen through the roots of certain plants to give protein polymers. The essentials of life in the lower and higher species are transferred from one generation to another through the medium of, in the custody of, and in the protection of polymers, such as in seeds, or in the protoplasm, or in the nucleoplasm.

The ascending scale of life is recognized as plant, animal, and man. In this scale, the polymers of the lower scale supply the food and energy for the higher scale, and thus animals subsist primarily on plants, and man subsists on animals as well as plants—and so feed bigger fish on little fish, and so ad infinitum.

These are but a few examples of a large number that could be enumerated to show the important role that polymers play in man's struggle for existence. Nature was most thoughtful in giving man and animals such materials as nails and hoofs as protective shields. To survive, living organisms must have physical form and coherence. To accomplish these objectives, nature synthesized those molecules which possess the requisite physical properties. We must agree that in this respect nature was not only a skillful chemist, but also an extraordinary mechanical and chemical engineer as well. The natural polymer, rubber, possesses elastic extensibility in a remarkable combination with high strength.

First models

The importance, the diversity, and the properties of these natural polymers in themselves was sufficient to challenge the ingenuity of the pioneer investigators. Eventually, but slowly, the confusion, the disagreements, the misunderstandings, that are part of almost every research investigation, disappeared and the structure of the extraordinary natural substances became known with certainty. Once these structures were known, scientific curiosity would not be satisfied until the deliberate synthesis of their counterpart had been achieved. It was actually on this basis that Staudinger prepared polystyrene as a model for rubber, polyoxymethylene as a model for cellulose, polyethylene oxide as a model for starch, and polyacrylic acid as a model for the albuminoids; and thus he established the fact that the extraordinary properties and behavior of the natural and synthetic polymers were fundamental and inherent in their very large molecular size and to their chain-like structure.

Progress Today

By 1930 when the sales of plastics were less than an estimated 25 million pounds per year, we arrived at a point in technical progress where we had a fair understanding of the processes by which we could synthesize a large number of polymers. The basic process consisted in joining simple related molecules, one to another, until large molecules were formed, which contained the starting molecules as repeating units in their structure. This was truly engineering on the molecular scale. The starting materials in the process ranged in size from about 10 to 100 angstroms, and these had to be joined together to produce polymer products ranging in size from 5,000 to perhaps 50,000 angstroms. Our understanding of the polymerization processes in 1930 was far from complete, but it was sufficient to have us realize that these materials we called plastics were a species of polymers, and that the known principles of polymerization could be applied to a better understanding and improvement of plastics. This actually happened, and as a result of continued molecular engineering, namely, research in polymerization, an upward swing occurred in the plastics industry. It started slowly in 1932, increasing in rate in 1934, and continued at an accelerated pace till in 1940 this industry was producing about 400 million pounds per year.

The Pearl Harbor attack followed in 1941. Overnight we were catapulted into World War II, a conflict of such major proportions that our very survival as a nation was at stake. This was a circumstance in which we had to focus the tremendous structure of accumulated scientific knowledge upon ourselves in a struggle for existence. The dynamic compulsion of war demanded that plastics contribute their share to winning the war. And when it was won, they were not found wanting. At the outbreak of the war, a number of industrial applications for plastics had already been firmly established, and we continued and expanded these. The unprecedented demands for aluminum, steel, leather, rubber, and other materials resulted in critical shortages and the search for substitutes began.

Plastics immediately filled in a large number of gaps, some with a success so outstanding that they surpassed in performance the material for which they were substituted. Others were not so successful, and some were dismal failures. The successes increased our confidences in the possibilities yet unexplored, and the failures cautioned us that plastics, like any other material, had its specific limitations as well as its attributes, and that product and end-use engineering must take both into account. In due time, we learned our lesson that we could not use plastics where the requirements of application indicated that another material should be used, any more than we would use tin or lead where hardened steel would be required. Just as we accepted the fact that glass would break, that iron would rust, or that cloth would burn, we also accepted the reality that we could not expect plastics to resist every known physical or chemical action. We also finally believed that there was no single plastic that had all the properties desirable in a plastic, just as no single metal or alloy has all the desirable properties of metals. We learned that we had to rely on a large number of plastics, each with individual outstanding properties. Nature, the unsurpassed engineer knew this, and she relied, not on one, but on an almost unlimited number of polymers to assist her in performing her diverse functions.

Tailor-made

In World War II, we also learned that in a number of cases none of the polymers available would completely fulfill the requirements of certain applications, although every analysis indicated that this was an application which properly belonged to the field of plastics. We referred such problems to the molecular engineers in the research laboratories. They took their cue from mother nature and by substituting different repeating units in the polymer structures, they synthesized new plastics with improved properties. For other uses it was necessary to synthesize polymers that contained different combinations of repeating units to obtain the specific properties desired; and we termed these compositions copolymers.

This cooperation of molecular engineers and product engineers in the field of plastics was team-work at its peak. As the War gained momentum, plastics shed the role of substitutes, and took their true place as a class of materials which, when applied correctly within their limitations, offered advantages in their own right. Within a short period of time, prac-

(Continued on Page 40)

A Committee Report

PLASTICS APPLICATIONS IN HOUSEHOLD APPLIANCES

—a Bibliography

Frank A. Martin, *Committee Chairman,*

The Hoover Company

The Household Appliances Sub-Committee made a start in 1949 to set up standard test procedures which might be acceptable to the industry. A tentative method of testing thermoplastic enclosures for appliances was published in the S.P.E. Journal, April 1950, and later reprinted in Electrical Manufacturing.

The attention of the committee was turned to the preparation of a bibliography of plastic applications on appliances. It was felt that such a bibliography might create interest in new plastics applications in appliances by reviewing what has been accomplished. It was necessary to define household appliances before starting the bibliography. A broad definition was adopted which included products used in the home which are in general electrically operated. The fields of radio and television, and refrigerators were not considered in the committee's definition of appliances, since these are such large users of plastics as to warrant individual treatment.

A preliminary search of the literature indicated that two main sources would yield nearly all of the references to the use of plastics in appliances. Chemical Abstracts was not considered a satisfactory reference, since we were primarily interested in the commercial applications of plastics rather than the fundamental properties of the materials. Therefore, the main sources of information were The Engineering Index, and Modern Plastics.

The bibliography has been completed for the years 1919-1928 and 1937-1950 inclusive. Abstracts for the years 1929-1937 are now in the process of preparation.

The preparation of the abstracts was largely the work of Mr. R. M. Hershey, assisted by Mr. K. R. Warburton, both of The Hoover Company. Their assistance in this work is gratefully acknowledged.

Thanks are also due to The Hoover Company for providing secretarial assistance.

COFFEE MAKERS

Make Mine Black—H. S. Spencer
Modern Plastics, Vol. 16, No. 3, November 1938, Pg. 59, 94
Plastic molded items have improved the appearance and sales of coffee brewers. Brewer base, handles, collars, neckbands, covers, trays, and creamer and sugar were changed to plastic.

Progress In Heatronic Molding—V. E. Meharg and A. P. Mazzucchelli
Modern Plastics, Vol. 21, No. 10, June 1944, Pg. 108-113, 160, 162
The general technique of heatronic molding of thermosetting materials is discussed. New applications and industrial installations as glass coffee makers were considered.

More Products In Plastics Are Here And to Come, Say Designers
Modern Plastics, Vol. 25, No. 3, November 1947, Pg. 77-84, 198, 200
The electric iron, coffee maker, washing machine agitator, and vaporizer have produced notable advances in the use of plastics.

Three Plastics Add to Beauty, Usefulness of Cookware Line
Modern Plastics, Vol. 25, No. 1, September 1947, Pg. 106-108
Melamine, phenolic, polystyrene contributed to the success of coffee makers.

How Cory Cut Finishing Costs
Modern Plastics, Vol. 27, No. 5, January 1950, Pg. 185-186
Cory coffee brewer made in plastic had finer appearance and cost 50% less than previous models.

Coffee Bowl Cover and Handle
Modern Plastics, Vol. 28, No. 10, June 1951, Pg. 180-181
Plastic parts of Cory coffee brewer were described.

DISH WASHERS

Acrylic Lid for Dishwasher
Modern Plastics, Vol. 25, No. 1, September 1947, Pg. 172, 174
Kaiser Fleetings' dishwasher used a fabricated transparent acrylic lid.

Good News for Dish Jockeys
Modern Plastics, Vol. 27, No. 8, April 1950, Pg. 92-93
The All-American automatic dishwasher had a polyester-glass mat tub.

FANS — AIR CONDITIONING

A New Idea In Cooling
Modern Plastics, Vol. 22, No. 12, August 1945, Pg. 104-105
Molded plastic parts of the home and office Welch circulator are described.

Plastics Win In A Breeze
Modern Plastic, Vol. 26, No. 12, August 1949, Pg. 81-82
Fresh'nd-Aire air circulators use molded butyrate housings and phenolic bases.

Ribbon Fan
Modern Plastics, Vol. 26, No. 12, August 1949, Pg. 144
The lightweight Ribbonaire ribbon bladed fan uses a phenolic housing.

Two Part Housing From Single Die
Modern Plastics, Vol. 28, No. 4, December 1950, Pg. 76-77
Phenolic housing used for Handybreeze Dial-Aire cabinet-type fan is made in two identical halves. Details of assembly are shown.

Fan Stand—Alfred F. Fukal (to Wm. W. Welch)
U.S. Pat. 2,294,399, Sept. 1, 1942
A stand for electric fans made using molded plastic hoops stacked above the base to house the motor and fan.

Clearing the Air
Plastics, Vol. 4, April 1940, Pg. 79-80
New household ventilating fan is made largely from phenolic plastics.

Balance In A Phenolic Fan Blade
Modern Plastics, Vol. 23, No. 8, April 1946, Pg. 165
Balance is achieved in Fresh'nd Aire Company's phenolic fan blades through the use of specially shaped and weighed preforms.

Report on Plastics for 1948—J. Delmonte
Elec. Mfg., Vol. 43, No. 1, Jan. 1949, Pg. 96-101, 176, 178, 180, 182
Plastic developments during 1948 are cited. An electric mixer, vacuum cleaner, and air circulator are reviewed.

Plastics In Four Home Appliances
Modern Plastics, Vol. 24, No. 1, September 1946, Pg. 108-110
Many uses were found for plastics in Philco's radios, refrigerators, home freezers, and home air conditioning units.

Modernizing a Humidifier
Modern Plastics, Vol. 28, No. 7, March 1951, Pg. 72-73
Plastic parts of Fresh'nd-Aire humidifier are described.

Air Conditioning Grille
Modern Plastics, Vol. 25, No. 9, May 1948, Pg. 85
Filtered air can be directed by finger-tip adjustment of a one-piece, round, cellulose acetate butyrate grille.

Phenolic Grilles
Modern Plastics, Vol. 25, No. 3, November 1947, Pg. 166
Phenolic intake and exhaust grilles are used in a room air-conditioner.

Balance In a Phenolic Fan Blade
Modern Plastics, Vol. 23, No. 8, April 1946, Pg. 165
Fresh'nd Aire fans use a phenolic propeller.

Thermoplastic Big Shots
Modern Plastics, Vol. 27, No. 11, July 1950, Pg. 55-62
Air circulator housing, refrigerator, television, and automobile applications illustrate the trend towards large injection molded pieces.

IRONS

The Work Horse Sets New Records
Modern Plastics, Vol. 28, No. 6, Feb. 1951, Pg. 55-60
The heat resistance of general purpose phenolics has been improved so that iron handles, once made only of asbestos-filled phenolic, are now almost all made of G. P. material.

Changing Styles in Iron Handles—J. H. Dubois
Modern Plastics, Vol. 23, No. 9, May 1946, Pg. 85-88
Several molded plastic iron handles are reviewed.

Plastics Are At Home In The Kitchen
Modern Plastics, Vol. 24, No. 8, April 1947, Pg. 192-194
Plastics have been adopted for use in the Sunbeam automatic toaster, Aladdin Knife Sharpener, and Glide-O-Matic Iron.

More Products In Plastics Are Here And to Come, Say Designers
Modern Plastics, Vol. 25, No. 3, November 1947, Pg. 77-84, 198, 200
The electric iron, coffee maker, washing machine agitator, and vaporizer have produced notable advances in the use of plastics.

Phenolics—Backbone of the Industry—Don Masson
Modern Plastics, Vol. 16, No. 2, October 1938, Pg. 42-43, 46
Electric iron parts illustrate the uses of phenolic plastic molded items.

Five Reasons For Phenolics In Mangles
Modern Plastics, Vol. 24, No. 12, August 1947, Pg. 107
Reasons for the use of phenolic plastics in Bendix home automatic ironers are given.

Steps In A Modern Design—J. C. Fagan
Prod. Eng., Vol. 11, No. 9, September 1940, Pg. 404-406
Steps in the development of the Proctor electric iron are described. Molded bakelite handles are used.

A Critical Study of Electric Flatirons—M. Brownshield
Elec. Mfg., Vol. 40, No. 3, Sept. 1947, Pg. 102-107, 186, 188, 190, 192
Good and bad features of design, materials, and workmanship are discussed. The application of plastic materials is reviewed.

Jobs Cast Plastics Can Do
Modern Plastics, Vol. 28, No. 4, December 1950, Pg. 59-63
Electric iron parts are among many of items cast from plastic materials.

Iron Features Phenolic and Acetate
Modern Plastics, Vol. 26, No. 6, October 1948, Pg. 95
Phenolic cover plate, control lever and a combination phenolic-acetate handle are used on Model 79-AB American Beauty iron.

A Flexible Iron
Modern Plastics, Vol. 25, No. 1, Sept. 1947, Pg. 168-169
Yale and Towne Tip Toe iron uses a phenolic handle and dial.

Furfural as a Chemurgic Product—E. E. Novotny
Modern Plastics, Vol. 15, No. 2, Oct. 1937, Pg. 25, 74, 76
Electric iron handles are an example of products which can be made from furfural-phenolic resins.

MIXERS

Mixer Container
Modern Plastics, Vol. 28, No. 6, February 1951, Pg. 151
Plastic parts of the Dormeyer Blender are described.

Progress in Plastics for 1948—J. Delmonte
Elec. Mfg., Vol. 43, No. 1, Jan. 1949, Pg. 96-101, 176, 178, 180, 182
Plastic developments during 1948 are cited. An electric mixer, vacuum cleaner, and air circulator are reviewed.

Progress In Flame Resistant Cellulose Acetate
Modern Plastics, Vol. 26, No. 9, May 1949, Pg. 66-69
Celanese Lumarith XF Flame resistant cellulose acetate is being used for electric mixer and other appliance housings.

Angle Engraving
Modern Plastic, Vol. 25, No. 11, July 1948, Pg. 156
Angle engraving used on electric food mixer selector switch dial permits a straight draw from the mold.

From Trim-Tab Motor to Hand Mixer
Modern Plastics, Vol. 23, No. 9, May 1946, Pg. 100-101
The motor used on the Gilbert electric mixer uses a cellulose acetate housing.

Modern Mixer
Modern Plastics, Vol. 16, No. 1, Sept. 1938, Pg. 27
Description of AC Gilbert Company's Kitchen Kit Electric food mixer which uses eight molded plastic parts.

Material Scarcities Inspired This Food Mixer Re-Design
Elec. Mfg., Vol. 28, No. 6, Dec. 1941, Pg. 67-9, 106, and 108; EI 1942, Pg. 314
Waring Blendor food mixer features plastic base replacing alloy casting, rubber mounted motor with more satisfactory characteristics and other improvements.

Acetate Houses Electric Mixer
Modern Plastics, Vol. 27, No. 9, May 1950, Pg. 77
Aro Spring Whip electric mixer has interlocking cellulose acetate housing.

Flame Resistance in Acetate—F. D'Alelio
Modern Plastics, Vol. 25, No. 12, Aug. 1948, Pg. 94-96
Flame resistant high acetyl cellulose acetate formulations have been approved by Underwriters' Laboratories for electric mixer and other appliance housings.

RANGES

Design Problems in Developing an Electric Range—T. H. Cline
Elec. Mfg., Vol. 43, No. 2, Feb. 1949, Pg. 100-103, 186, 188, 190, 192
Methyl methacrylate bezel is utilized in the development of an electric range.

Hobbing vs. Machining in Plastics Mold Making—J. Hohl
Indus. Plastics, Vol. 2, No. 9, Feb. 1947, Pg. 22-24, 38; EI 1947, Pg. 888
Advantages of hobbed cavities from standpoint of economy are reviewed. Products produced in hobbed cavities when cost of machined cavities are prohibitive include knobs, radio dials, stove dials, etc.

RECORDERS

More Plastics In Tape Recorder
Modern Plastics, Vol. 28, No. 8, April 1951, Pg. 80
The Webster-Chicago Model 210 tape recorder utilizes several plastic components.

More Phenolic In Record Changer
Modern Plastics, Vol. 28, No. 7, March 1951, Pg. 130
Plastic parts of RCA-Victor phonograph record player are described.

Holding All Records—A. Hayward
Modern Plastics, Vol. 17, No. 4, Dec. 1939, Pg. 34, 68, 70
A case history of the RCA phenolic record rack is presented. It is an example of a simple design which proved difficult to mold.

Plastics From Hydrolyzed Lignocellulose—R. Katzen, A. O. Reynolds, and D. F. Othmer
Modern Plastics, Vol. 20, No. 2, October 1942, Pg. 91-97, 122, 124
A phonograph pickup arm and electrical connectors are prepared from lignocellulose compounds.

Phonograph Needles—W. H. Hunter
U. S. Patent 2,452, 304, October 26, 1949
A phonograph needle comprising a stylus, a chuck engaging portion, and a nylon connecting portion is described.

Proposed Designs For Wire Recorders—W. C. Nichols and J. Palma, Jr.
Modern Plastics, Vol. 22, June 1945, Pg. 103-105
Several designs employing plastic housings are suggested.

Phenolic Record Player
Modern Plastics, Vol. 25, No. 9, May 1948, Pg. 152
A phenolic record player cabinet produced for Motorola is described.

Record Player Steps Out In Plastic
Modern Plastics, Vol. 25, No. 7, March, Pg. 84-86
The portable Carousel record player, molded in phenolic, matches the polystyrene record carrier.

SHAVERS

Visual Presentation
Modern Plastics, Vol. 15, No. 10, June 1938, Pg. 25
Remington-Rand electric razor transparent housing makes an effective display item.

An Appraisal of Polystyrenes In Electrical Applications—W. C. Gogglin
Elec. Mfg., Vol. 39, No. 2, Feb. 1947, Pg. 83-86; EI 1947, Pg. 340
The electrical properties of styrene derived resins are reviewed with applications such as electric razor housing and sandwich grill cited.

Selling With Plastics Displays
Modern Plastics, Vol. 26, No. 3, Nov. 1948, Pg. 75-82
Plastic displays help sell electric razor as well as many other items.

New Shick Shaver—L. Guilmart and J. H. Dubois
Modern Plastics, Vol. 26, No. 8, April 1949, Pg. 65-67
Seven plastic materials are used in Shick "400" Shaver. Design and reason for use of materials is discussed.

Industrial Design—What Is It—G. Stahl
Modern Plastics, Vol. 23, No. 11, July 1946, Pg. 109-110
Elements in the good design of an electric razor are discussed and illustrated.

Three Razors, Three Materials
Modern Plastics, Vol. 24, No. 1, Sept. 1946, Pg. 104-105
Polystyrene, phenolic, and urea-formaldehyde find uses in electric razors.

Two Shavers that Use Plastics
Modern Plastics, Vol. 25, No. 1, Sept. 1947, Pg. 178-180
Collman 58 and Gem Guiding Eye electric razors make effective use of plastics.

Radically New Shaver
Modern Plastics, Vol. 27, No. 1, Sept. 1949, Pg. 79-80
Sunbeam electric razor has 17 plastic parts made of four materials.

Housing Midget Motors—C. R. Simmons
Modern Plastics, Vol. 15, No. 11, July 1938, Pg. 27, 64, 65
Plastics provide the only practical solution to electric razor and electric tooth brush housing problem.

Flame Resistance in Acetate—F. D'Alelio
Modern Plastics, Vol. 25, No. 12, August 1948, Pg. 94-96
Flame resistant high acetyl cellulose acetate formulations have been approved by Underwriters' Laboratories for electric shaver and other appliance housings.

Progress In Flame Resistant Cellulose Acetate
Modern Plastics, Vol. 26, No. 9, May 1949, Pg. 66-69
Celanese Lumarith XF flame resistant cellulose acetate is being used for electric shaver and other appliance housings.

Change In Shape Involves More Than Styling—C. Otto and N. Gray
Elec. Mfg., Vol. 48, No. 4, Oct. 1951, Pg. 108-112, 268, 270, 272, 274
Close coordination between the engineering department and industrial designer developed the Shick "20" electric shaver.

Electric Shaver—Last Word In Compact Design
Machine Design, Vol. 10, No. 4, April 1938, Pg. 24-26
Practically all electric shaver designs employ a molded plastic housing.

TOASTERS

Plastics Are At Home In The Kitchen
Modern Plastics, Vol. 29, No. 8, April 1947, Pg. 192-194
Plastics have been adopted for use in Sunbeam automatic toaster, Aladdin knife sharpener, and Glide-O-Matic iron.

Two Acrylic Phenolic Applications
Elec. Mfg., Vol. 43, No. 3, March 1949, Pg. 122,124
Illustrated case histories of use of acrylic resins in combination with phenolics for automatic toaster and electric blanket control elements are given.

Plastics Models Can Help Product Development Work—A. E. Javitz
Elec. Mfg., Vol. 43, No. 2, Feb. 1949, Pg. 112-117, 178, 180, 182
Transparent working models, cast phenolic models, and photoelastic resin models for stress analysis are described. Their use in the development of an automatic toaster are described.

VACUUM CLEANERS

Lewyt Turns To Plastics
Modern Plastics, Vol. 29, No. 2, Oct. 1951, Pg. 103-105
The plastic parts used on the Lewyt vacuum cleaner are illustrated and described.

Color In Shock Resistant Materials
Modern Plastics, Vol. 23, No. 6, Feb. 1946, Pg. 128-129
Shock resistant melamine molding compounds add color to washing machine agitators, vacuum cleaner housings, etc.

Canadian Electrical Code—II Essential Requirements and Minimum Standards Covering Electrical Equipment
Can. Eng. Standards Assoc., Spec. C 22.2—N-67—1942, EI 1942, Pg. 322
Specifications for construction and test of portable electric vacuum cleaners are given.

Soft Products For Hard Use Molded of Elastomeric Vinyls
Modern Plastics, Vol. 28, No. 1, Sept. 1950, Pg. 73-78, 166, 167
Elastomeric vinyl molded parts find use in many products including Hoover vacuum cleaner. Compounding and molding problems are reviewed.

Vacuum Cleaners Use More Plastics
Modern Plastics, Vol. 27, No. 2, Oct. 1949, Pg. 80-81
Singer and Eureka vacuum cleaners use several different vinyl, ethyl cellulose, cellulose acetate, acrylic, cellulose acetate butyrate, and phenolic moldings.

Elektr. Haushaltapparate von Gebr. Buehler, Uzwil Schweizerische
Bauzeitung, Vol. 117, No. 16, April 19, 1941, Pg. 183-5, EI 1941, Pg. 1253
New vacuum cleaners and floor cleaning and waxing machine built by Buehler, Uzwil, Switzerland is illustrated and described.

Household Cleaner Is Designed for Abuse—F. B. Jacobs
Machine Design, Vol. 12, No. 4, April 1940, Pg. 36-37, EI 1940, Pg. 1263
Royal electric vacuum cleaner is described. Plastic plugs are utilized for protecting wiring connections.

Five Advantages of Acetate Moth Suffocator
Modern Plastics, Vol. 24, No. 12, Aug. 1947, Pg. 101
Cellulose acetate moth killer attachment for vacuum cleaner is described.

Compactness, Reduced Noise Achieved in Domestic Unit—C. G. Troxler
Machine Design, Vol. 12, No. 6, June 1940 Pg. 48-50, EI 1940, Pg. 1263
Uses of phenolics and nylon in Hoover Model 60 electric vacuum cleaner are described.

Testing is Function of Product Development—G. P. Daiger
Elec. Mfg., Vol. 42, No. 4, Oct. 1948, Pg. 167-71, 230, 232, 234, 236, EI 1948, Pg. 1298
An outline of the methods and special test equipment used by Hoover in the performance testing of the new cleaner designs.

Design Improvements Achieved at No Added Cost—R. C. Osborn
Elec. Mfg., Vol. 40, No. 4, Oct. 1947, Pg. 150-153, 240, 242, 244, EI 1947, Pg. 1205
Plastic and non-plastic components of Eureka Model 210 vacuum cleaner are described.

Cellulosics In Your Electrical Product Design—E. K. Oliver
Elec. Mfg., Vol. 39, No. 6, June 1947, Pg. 93-97, 158, 160, 162, 164, 166, EI 1947, Pg. 340
The properties of cellulosic plastics relative to their use in electrical products, ceiling fixtures, manicuring tool, hairbrush, food mixer housing, wall clock and vacuum cleaner parts are reviewed.

Assembly Accessories
Modern Plastics, Vol. 16, No. 11, July 1939, Pg. 46
The Hoover Model 305 cleaner which uses a plastic motor case, plastic hood, and other molded phenolic parts is presented.

Sweeping Progress
Modern Plastics, Vol. 16, No. 11, July 1939, Pg. 46
The Hoover Model 305 cleaner which uses a plastic motor case, plastic hood, and other molded phenolic parts is presented.

Phenolic Resin Progress—H. S. Spencer
Modern Plastics, Vol. 15, No. 2, Oct. 1937, Pg. 32-34, 102, 104
Phenolic resins have been adopted for electric razor

housings, vacuum cleaner housings, telephones, and many other products.

Seeing Is Believing
Modern Plastics, Vol. 26, No. 6, February 1949, Pg. 80-81
A transparent acrylic bowl helps to sell Rexair cleaners.

Application Trends in 1950
Modern Plastics, Vol. 28, No. 5, Jan. 1951, Pg. 65-70
New applications of plastics during 1950 are reviewed. Additional plastic parts are being used on Hoover vacuum cleaner, Apex dishwasher, washing machine agitators, and Cory air circulator.

Economics of Extrusion
Modern Plastics, Vol. 26, No. 5, January 1949, Pg. 79-81
Economic factors in plastics extrusion are examined. Light weight post formed vacuum cleaner tools made from ethyl cellulose are cited.

Five Plastics In A Cleaner
Modern Plastics, Vol. 27, No. 8, April 1950, Pg. 102-103, 204
The Kirby vacuum cleaner incorporates plastics for lighter weight, greater strength, better appearance, and improved fit of parts.

Electro-Sweep Switches to Plastics
Modern Plastics, Vol. 27, No. 5, Jan. 1950, Pg. 186-187
Electro-Sweep rug cleaners now uses a phenolic housing.

Flame Resistance in Acetate—F. D'Alelio
Modern Plastics, Vol. 25, No. 12, August 1948, Pg. 94-96
Flame resistant high acetyl cellulose acetate formulations have been approved by Underwriters' Laboratories for vacuum cleaner and other appliance housings.

Role of the Industrial Designer
Product Engineering, Vol. 21, No. 9, September 1950, Pg. 113-118
The role of the industrial designer in the development of the Hoover vacuum cleaner plastic hoods and lens is discussed.

Molding With Non-Critical Materials—C. P. Morgan
Modern Plastics, Vol. 20, No. 3, November 1942, Pg. 60-61
Colemorite produced by Vulcanized Rubber Co. is a thermosetting molding compound made from lignocellulose fibers. The material has been used for suction blades and closures of many kinds.

Application Trends In 1950
Modern Plastics, Vol. 28, No. 5, Jan. 1950, Pg. 65-70
Plastics have found a definite use in vacuum cleaners, dishwashers, and other items.

Soft Products For Hard Use—Molded of Elastomeric Vinyls
Modern Plastics, Vol. 28, No. 1, Sept. 1950, Pg. 73-78, 166, 167
Methods of compounding and molding elastomeric vinyls are discussed. Vacuum cleaner applications are suggested.

Vacuum Cleaners Use More Plastics
Modern Plastics, Vol. 27, No. 2, Oct. 1949, Pg. 80-81, EI 1949, Pg. 1237
Examples of the manner in which plastics are used in upright vacuum cleaners are presented.

Progress on Plastics for 1948—J. Delmonte
Modern Plastics, Vol. 43, No. 1, Jan. 1949, Pg. 96-101, 176, 178, 180, 182
Plastic developments during 1948 are cited. An electric mixer, vacuum cleaner, and air circulator are reviewed

New Tank Cleaner Features Phenolics
Modern Plastics, Vol. 25, No. 4, Dec. 1947, Pg. 108-109
Hoover tank cleaner uses nine parts molded from phenolic and ethyl cellulose plastics.

The Container, Too, Is An Integral Element in Product Design—A. E. Javitz
Elec. Mfg., Vol. 41, No. 2, Feb. 1948, Pg. 86-91, 186, 188, 190
Sound package engineering is as important for a vacuum cleaner as for any other item.

Adding Color To Vacuum Cleaners
Modern Plastics, Vol. 23, No. 7, March 1946, Pg. 117-118
The use of plastics adds color to Eureka vacuum cleaners.

Vacuum Cleaners For Home and Car
Modern Plastics, Vol. 24, No. 6, Feb. 1947, Pg. 106-107
Plastics are being used in increasing amounts in home and auto vacuum cleaners.

Sweeping In Thermoplastics—H. R. Husted
Modern Plastics, Vol. 19, No. 9, May 1942, Pg. 40-43
A review of achievements in injection molded vacuum cleaner housings and accessories.

What's In a Vacuum—C. H. Taylor
Modern Plastics, Vol. 18, No. 12, Aug. 1941, Pg. 42-43, 84
Molded plastics help Westinghouse achieve strength, appearance, and simplify assembly in their vacuum cleaners.

Industrial Designing Is a Profession—H. Dreyfuss
Elec. Mfg., Vol. 20, No. 4, Oct. 1937, Pg. 48-50, 124, EI 1937, Pg. 343
Hoover vacuum cleaners and parts are designed for efficiency and appearance.

Re-designing Plastics Motor Hood—F. A. Martin
Elec. Mfg., Vol. 48, No. 5, Nov. 1951, Pg. 131-132
The Hoover Model 29 and 62 vacuum cleaner motor hoods were molded from cellulose acetate to obtain impact resistance and a choice of colors.

What's Happening With E. C.
Modern Plastics, Vol. 29, No. 4, Dec. 1951, Pg. 99-103, 195, 197
Lightweight and strong vacuum cleaner parts can be produced from ethyl cellulose.

The Hoover One Fifty—K. O. Tooker and F. L. Pierce
Modern Plastics, Vol. 15, No. 4, Nov. 1936, Pg. 32-33, 62, 63
Molded plastics contribute to the appearance and performance of the Hoover Model 150 vacuum cleaner.

Design Right Plastic Into Your Major Appliance—F. A. Martin
Elec. Mfg., Vol. 45, No. 1. Jan. 1950, Pg. 60-65, 154, 156, 158, 160, 162, 164, EI 1950, Pg. 321
Reasons for using plastic materials as components of home appliances are cited. Special reference is made to experience of Hoover Co. with vacuum cleaner parts.

Lighter Than Steel
Modern Plastics, Vol. 29, No. 4, Dec. 1951, Pg. 123-125
The Lewyt vacuum cleaner uses 16 plastic parts which were formerly made of more critical materials.

Polyester Vacuum Cleaner Dust Bowl
Elec. Mfg., Vol. 48, No. 6, Dec. 1951, Pg. 134
The Lewyt Corp. replaced steel with reinforced glass

polyester in their vacuum cleaner dust bowl.

Printed Panels Aid Salesmen
Modern Plastics, Vol. 29, No. 4, Dec. 1951, Pg. 106
Illuminated rigid vinyl panels are central features of a Hoover Co. vacuum cleaner display unit.

WASHERS

Color in Shock Resistant Materials
Modern Plastics, Vol. 23, No. 6, Feb. 1946, Pg. 128-129
Shock resistant melamine molding compounds add color to washing machine agitators, vacuum cleaner housings, etc.

More Products In Plastics Are Here And to Come, Say Designers
Modern Plastics, Vol. 25, No. 3, Nov. 1947, Pg. 77-84, 198, 200
The electric iron, coffee maker, washing machine agitator, and vaporizer have produced notable advances in the use of plastics.

What's Ahead for 1946
Modern Plastics, Vol. 23, No. 5, Jan. 1946, Pg. 91-106
Predictions of future developments in the use of plastics for washing machines, electric irons, and vacuum cleaners as well as many other items are made.

Fabricators Must Be Versatile
Modern Plastics, Vol. 25, No. 2, Oct. 1947, Pg. 124-166
Custom fabricators reproduce a washing machine tub in acrylic.

How Big Can Molded Pieces Be?
Modern Plastics, Vol. 25, No. 2, Oct. 1947, Pg. 101-106
Examples of large size compression molded plastics as washing machine agitators are cited.

Transparent Washing Machine Uses Acrylic
Modern Plastics, Vol. 25, No. 8, April 1948, Pg. 190
Sears' demonstration washers use transparent acrylic parts for display purposes.

Better Washer Liner Costs Less
Modern Plastics, Vol. 27, No. 8, April 1950, Pg. 93-94
Reinforced plastic unit replaced aluminum in Apex automatic washing machine, and produced a 25% cost saving.

Washing Machine Parts
Modern Plastics, Vol. 26, No. 11, July 1949, Pg. 126
Four Fiberglas-reinforced laminate parts have replaced metal parts in washing machines manufactured by Apex Electrical Mfg. Company.

The Proof Is In the Washing
Modern Plastics, Vol. 27, No. 8, April 1950, Pg. 120-121
Phenolic washing machine agitators have recognized superior features.

Nylon Plastics For Mechanical Parts
Plastics Bulletin, Vol. 12, No. 47, 1950, Pg. 187-190
Nylon gears for egg beaters, electric shavers, washing machines, electric mixers and stove drawers are mentioned and illustrated.

Lignin-enriched Filler—J. G. Meiler
Modern Plastics, Vol. 20, No. 1, Sept. 1942, Pg. 64-66, 128, 130
Lignin is a non-critical extender for phenolic molding compositions and is satisfactory for washing machine agitators and other items.

Plastics; Designs For Speedier Production
Product Eng., Vol. 12, No. 4, April 1941, Pg. 210-214, EI 1941, Pg. 954
A washing machine agitator is illustrated.

Soap Injector for Automatic Washer
Modern Plastics, Vol. 26, No. 2, Oct. 1948, Pg. 84
Phenolic parts are used in the soap injector on the Bendix automatic washer.

Look to Structural Plastics for the Housings of Electrical Products—F. Z. Pearson
Elec. Mfg., Vol. 38, No. 4, Oct. 1946, Pg. 142-146, 204, 206
There are many uses of cellulose acetate, ethyl cellulose, and thermosetting plastics in housings for electrical products such as radios, refrigerators, and washing machines.

Three Million Units, Three Pounds Each
Modern Plastics, Vol. 27, No. 5, Jan. 1950, Pg. 183-184
Washing machine agitators are being switched to phenolic plastics.

Color In Shock Resistant Materials
Modern Plastics, Vol. 23, No. 6, Feb. 1946, Pg. 128-129
Washing machine agitators are produced from shock resistant colored molding compounds.

MISCELLANEOUS

What's Ahead For 1946
Modern Plastics, Vol. 23, No. 5, Jan. 1946, Pg. 91-106
The uses of plastics during 1946 are predicted. Washing machine agitators, irons, toasters, and stoves are covered.

Flame Resistant Cellulose Acetate—C. Sundberg
Elec. Mfg., Vol. 42, No. 3, Sept. 1948, Pg. 82-85, 182, 184, 186, EI 1948, Pg. 365
Properties, production methods, and appliance enclosure design suggestions for flame resistant cellulose acetate are given.

Metal and Plastics In Product Design—John Delmonte
Elec. Mfg., Vol. 47, No. 6, June 1951, Pg. 98-101, 254, 256, 258
Many qualities impossible to attain with the use of plastic or metal alone can be obtained with a combination of the two materials.

Technik in Haushalt und Kleingewerbe—H. Mengeringhausen
Technische Ber (Leipsizer Messant), No. 17, 1936, Pg. 1-8, EI-1936, Pg. 329
Developments in household and small trade appliances, as noted at the Leipzig Fair of 1936 are illustrated and reviewed.

Neglected Factors In Design of Consumer Products—M. Brownshield
Prod. Eng., Vol. 19, No. 8, Aug. 1948, Pg. 81-84, EI 1948, Pg. 972
Essentials which should be checked in development stage for successful design of any product are reviewed. A reference is made to the use of plastics in household appliances.

Using Plastic Color—F. Brill
Modern Plastics, Vol. 16, No. 2, Oct. 1938, Pg. 105-112, 172
The use of color in home appliances is discussed.

Plastics
Prod. Eng., Vol. 19, No. 9, Sept. 1948, Pg. 129-152
The general advantages of the use of plastics in home appliances are reviewed.

Properties and Characteristics of Melamine-Formaldehyde
Prod. Eng., Vol. 15, No. 2, Feb. 1944, Pg. 99-101, EI 1944, Pg. 807
Examples of properties and uses of melamine-formaldehyde resins in tableware, closures housings, lighting reflectors, knobs are reviewed.

Kitchen Prototype—Designed for Plastics
Modern Plastics, Vol. 22, No. 10, June 1945, Pg. 97-101
Designs were suggested by P. Muller-Munk, industrial designer, for Don Chemical Co. Kitchen accessories and appliances are described and illustrated.

Attachment Plugs and Receptacles
Underwriters Laboratories, Inc.—Nat. Board Fire Underwriters—Standard, Sept. 1939, Pg. 5-27, EI 1939, Pg. 362
Requirements for cover attachment plugs and receptacles, cord connectors, some forms of current taps, and flatirons and appliance plugs for use in accordance with National Electrical Code are listed.

Requirements for Cord Sets
Underwriters Laboratories, Inc.—Nat. Board Fire Underwriters, October 1937, EI 1937, Pg. 343
Requirements for cover cord sets for use as supply connections for portable appliances are listed.

Canadian Electrical Code—II Essential Requirements and Minimum Standards Covering Electrical Equipment
Can. Eng. Standards Assoc.—Spec. C 22.2—N-68—1942
Specifications for construction and test of motor operated domestic and commercial appliances are given.

Wear Tests of Plastics—N. N. Sawin
Engrs' Digest (British Edition), Vol. 8, No. 10, Oct. 1947, Pg. 333-336; Engrs' Digest (Amer. Edition), Vol. 4, No. 10, Oct. 1947, Pg. 451-454; Tool Engr., Vol. 19, No. 5, Dec. 1947, Pg. 17-20, EI 1947, Pg. 891
Tests of different kinds of plastics used in manufacture of bearings, bushings, gears, rails, etc., in electrical equipment, household appliances and other articles are listed.
English abstract from Maschinenbau & Waermewirtschaft, Vol. 1, No. 5/6, Nov. Dec. 1946, Pg. 103-108.

Five Case Studies of Phenolics At Work—E. F. Borro
Elec. Mfg., Vol. 41, No. 5, May 1948, Pg. 114-118, EI 1948, Pg. 365
The design study of an electrically heated insecticide dispenser is reviewed.

Design for Plastic Products
Modern Plastics, Vol. 18, No. 4, Dec. 1940, Pg. 48, 94, 96
The design possibilities of plastics in waffle irons and other products were reviewed in an address by J. O. Reinecke.

Progress In Flame Resistant Cellulose Acetate
Modern Plastics, Vol. 26, No. 9, May 1949, Pg. 66-69
Celanese Lumarith XF flame resistant cellulose acetate is being used for facial vibrator and other appliance housings.

Plastics Are At Home In The Kitchen
Modern Plastics, Vol. 24, No. 8, April 1947, Pg. 192-194
Plastics have been adopted for use in the Sunbeam automatic toaster, Aladdin knife sharpener, and Glide-O-Matic Iron.

More Products In Plastics Are Here And To Come, Say Designers
Modern Plastics, Vol. 25, No. 3, Nov. 1947, Pg. 77-84, 198, 200
The electric iron, coffee maker, washing machine agitator, and vaporizer have produced notable advances in the use of plastics.

Flame Resistance in Acetate—F. D'Alelio
Modern Plastics, Vol. 25, No. 12, Aug. 1948, Pg. 94-96
Flame resistant high acetyl cellulose acetate formulations have been approved by Underwriters' Laboratories for blanket switches and several other appliance housings.

Video Images Enlarged
Modern Plastics, Vol. 25, No. 8, April 1948, Pg. 114-116
A two piece acrylic lens filled with clear mineral oil magnifies television screens two to three times.

Four Million Pounds A Year
Modern Plastics, Vol. 27, No. 5, Jan. 1950, Pg. 114-116, 251
The story of the telephone is a progress story of the use of plastics.

Phenolic Base For Home Sterilizer
Modern Plastics, Vol. 23, No. 10, June 1946, Pg. 105
Phenolic base is used on the baby bottle sterilizer produced by Electric Steam Radiator Corp.

Cleans Cleaner, Wears Longer
Modern Plastics, Vol. 27, No. 5, Jan. 1950, Pg. 123
Nylon bristles do a superior job in rub :scrubbing machines.

Pencil Sharpener Housing of Styrene Copolymer
Modern Plastics, Vol. 26, No. 8, April 1949, Pg. 138
Point-O-Matic electric pencil sharpener housing is fabricated from Royalite, a high styrene-butadrene-acrylonitrile sheet material.

Molded Housing For Electric Manicurer
Modern Plastics, Vol. 24, No. 4, Dec. 1946, Pg. 109
White and red cellulose acetate are used for the housing of Matthews home manicuring set.

From Zinc to Acetate
Modern Plastics, Vol. 28, No. 3, Nov. 1950, Pg. 90
Cory electric knife sharpener uses a molded cellulose acetate housing.

Super Juice Extractor
Modern Plastics, Vol. 18, No. 11, July 1941, Pg. 42, 96
Redesigned Dazey fruit juice extractor is completely plastic and molded from polystyrene and methyl methacrylate.

Styrene's March of Triumph
Modern Plastics, Vol. 28, No. 3, Nov. 1950, Pg. 78-81, 174
Polystyrene molded parts find use in lighting fixtures, hair driers, and other large appliances. Recent improvements in molding materials are reviewed.

Electric Hair Brush
Modern Plastics, Vol. 26, No. 10, June 1949, Pg. 144
The Vitabrush electric hair brush contains a phenolic handle, nylon bristles, and molded nylon bristle holders.

Six Uses for Plastic In An Electric Brush
Modern Plastics, Vol. 24, No. 4, Dec. 1946, Pg. 105
Ethyl cellulose, butyrate, phenolic, nylon, and vinyl plastics are used in the Gyra electric hair brush.

Designing an Electric Appliance With Help of Safety Standrds
Elec. Mfg., Vol. 39, No. 6, June 1947, Pg. 83-85
The Casco heating pad thermostat is enclosed in a plastic housing.

Phenolic Control for Electronic Blanket—D. Maxwell
Modern Plastics, Vol. 23, No. 8, April 1946, Pg. 137
Simmons electronic blanket uses a molded phenolic housing for its control element.

Deodorizer Dressed Up in Acetate
Modern Plastics, Vol. 27, No. 2, October 1949, Pg. 77
The Y & Y Electric Deodorizer housing is molded from flame resistant cellulose acetate.

Dehumidifier
Modern Plastics, Vol. 28, No. 3, Nov. 1950, Pg. 158
Dri-Z-Air dehumidifier uses cellulose acetate plastic.

Kunst- and Presstoffe in der Haustechnik und in Haushalt—G. Ehlers
Kunststoffe, Vol. 30, No. 1, Jan. 1940, Pg. 13-15- EI 1940, Pg. 926
The uses of plastics in the manufacture of household products and appliances are surveyed.

Putting Insulating Properties of Plastics to Work
Modern Plastics, Vol. 24, No. 6, Feb. 1947, Pg. 134-135
Plastics find use in an electric hot dog cooker, a baby bottle warmer, and a percolator.

Realities or Reveries
Modern Plastics, Vol. 21, No. 8, April 1944, Pg. 73-81, 172, 174, 176, 178
A review of tomorrow's molded and fabricated small wares—strainers, scoops, salt shakers, measuring cups and spoons, cups, dishes, funnels, electric mixers and juicers, tea strainers, washing machine agitators, vacuum cleaner housings.

Art In Plastics Design—R. J. Hill
Modern Plastics, Vol. 59, No. 12, Dec. 1937, Pg. 914-916
The use of plastics in the design of household appliances is reviewed.

Designing For Materials Conservation
Product Eng., Vol. 14, No. 4, April 1942, Pg. 182-246, EI 1942, Pg. 645
Achievements in the substitution of plastics and other materials for scarce materials were presented in a symposium.

Redesigned Humidifier
Modern Plastics, Vol. 29, No. 4, Dec. 1951, Pg. 104-105
The Daffin dehumidifier was designed using phenolic and styrene in structural parts.

Specifying Appliance Plastics Housings
Elec. Mfg., Vol. 45, No. 6, June 1950, Pg. 122, 124, 126, EI 1950, Pg. 338
Test specifications for thermoplastic household appliance enclosures outlined by Society of Plastic Engineers.

Plastics Build Better Products and Better Values
Modern Plastics, Vol. 27, No. 5, 8, Jan. 1950, Pg. 105-280, Apr. Pg. 91-122
A review of advances in product design which includes electrical applications and home appliances.

Tentative Test Specifications and Requirements for Thermoplastic Enclosures For Electrical Appliances
Soc. Plastics Engrs. J., Vol. 6, No. 4, Apr. 1950, Pg. 5, 10, EI 1950, Pg. 321
Specifications applicable to thermoplastic housings of electrical appliances are given.

Characteristics of Molding Compounds—The Phenol Resins
Am. Mach., Vol. 67, No. 26, Dec. 29, 1927, Pg. 1027
Used to replace metal castings and sheet metal for handles, panels, thumb nuts, silent gears, and radio and electrical parts; substitutes for hard rubber and wood; etc.

Bakelite Molding Methods—F. W. Curtis
Am. Mach., Vol. 68, No. 9, Mar. 1, 1928, Pg. 361-364
Methods applied in making bakelite products and constructional features of dies and presses used by Reynolds Spring Co.; including ten-unit mold assembly for making section of electric cord connection.

Molded Insulating Materials in the Electrical Industry—I. Sommerfeld
Plastics, Vol. 3, No. 6, June 1927, Pg. 263-264
Requirements of modern practice and recent steps toward standardization.

Remarkable Versatility of Pyroxylin—W. S. Segal
Plastics, Vol. 2, No. 11, Nov. 1926, Pg. 387-388 and 416
Presents list of use of pyroxylin plastics as culled from index of most comprehensive book on subject.

Characteristics of Molding Compounds—Casein and Pyroxylin Plastics
Am. Mach., Vol. 68, No. 1, Jan. 5, 1928, Pg. 31
Casein plastics made from casein precipitated from skim milk by action of rennet; used for electrical and mechanical parts.

Cellulose Acetate Molding Powders
Plastics, Vol. 4, No. 11, Nov. 1928, Pg. 635-637
Some examples of transparent molded products; electrical appliances which are designed to hold insulating oils are eminently satisfactory when molded of these powders.

COMPETITIONS & AWARDS

Second Annual Modern Plastics Competition
Modern Plastics, Vol. 15, No. 3, Nov. 1937, Pg. 29-52
Awards for a Hoover vacuum cleaner, a Chase coffee urn and Sears kitchen scale are announced.

Third Annual Modern Plastics Competition Awards
Modern Plastics, Vol. 16, No. 3, Nov. 1938, Pg. 27-53
Awards were made for a home radio transmitter, waffle iron, and steam iron in the household field.

Fifth Annual Modern Plastics Competition—1940
Modern Plastics, Vol. 18, No. 2, Oct. 1940, Pg. 41-111
Awards were made for a washing machine agitator, clocks, and light fixture in the household field.

Sixth Annual Modern Plastics Competition Award 1941
Modern Plastics, Vol. 19, No. 3, Nov. 1941, Pg. 82-101
Awards were given for vacuum cleaner, washing machine parts and humidifier.

Seventh Annual Modern Plastics Competition
Modern Plastics, Vol. 26, No. 1, Sept. 1948, Pg. 109-183
Awards were given for the application of plastics in a washing machine and in the Roto-Beam air circulator.

Successful Designing For Plastics Molding

W. M. Halliday

The relationship between the method of manufacture to be adopted in producing a plastics component, and the permissable design forms which may be incorporated, form the subject of this installment.

Perhaps the chief single factor calling for consideration at this stage is that of the determination of the method

Table 1.

Thermo-setting Materials

FORMS

Molding: Powders, granules, fibres, macerations, pellets.
Extrusions: Rods, tubes, special forms.
Castings: Produced by cold process to standard shapes.
Laminates: Rods, tubes, sheets.
Coatings.
Adhesives.

Manipulating and fabricating processes employed	Tools and equipment necessary
Casting by cold process	Molds—dies.
Compression molding	Molds with press machine.
Transfer molding	Mold with press machine.
Slush molding	Simple molds—fixtures.
Blow molding	Dies—forming vessels.
Pulp molding	Molds—impregnating tools.
Solvent molding	Molds in metal—ceramics.
Extrusion	Dies and extruder machine.
Lamination	Form press tools—jigs—fixtures.
Welding—cementation	High-frequency welding machine.
Built-up construction	Fixtures—jigs,etc.
Wholly machining	Usual cutting tools—machine tools.

Thermo-plastic Materials

FORMS

Molding powders.
Extrusions: Rods, tubes.
Sheets.
Coatings.
Films.
Fibres.
Laminates.
Adhesives.
Standard extruded sections and shapes.

Manipulating and fabricating processes employed	Tools and equipment necessary
Casting by cold process	Molds—dies—simple press.
Molding—(a) compression, (b) injection	Molds—injection machine—press.
Extruding	Dies with extruder machine.
Forming—bending	Simple forming—shaping tools.
Welding	Welding equipment—fixtures.
Lamination	Form tools—presses.
Blow molding	Molds—simple jigs.
Film formation	Special appliances.

of manufacture of the proposed component, and the various ways in which its design form will be influenced thereby. This will assume particular importance if the part has to be produced as a molding by one of the recognized processes.

For the successful solution of this problem, the designer of the component must possess some knowledge of the general practical features and techniques employed in these processes. To a lesser extent, he must also have some knowledge of the principles and procedures followed in the manipulation and fabrication of plastics as set forth in Table 1.

If he is not **au fait** with the requirements, limitations and potentialities of these different plastics-forming and molding methods and processes, it will be very easy to introduce design features which are unsuitable for economical production.

Often, even though the finished product may prove satisfactory from all the above considerations, its cost of manufacture may be very expensive. Cost, of course, is a very important factor to be considered by the designer indeed, in many cases it is a crucial factor. Selection of an unsuitable method of manufacture, or the inclusion of unsatisfactory design features for such a method of production, will often entail added expense.

Before a decision can be taken on the form or method of production to be adopted, the undermentioned factors, amongst others, must be considered and satisfactorily determined:—

(1) The shape of the component and any other critical design features must be carefully examined in the light of the requirements connected with the proposed manufacturing method. This will necessitate deciding whether the design forms are capable of being economically and successfully reproduced by such a process, or whether an alternative method is available whereby production will be simplified, giving lower costs or an improved component.

Consideration afforded to these and kindred questions will often result in modifications of the component design to conform to the requirements of the selected process. Consultations can very usefully be engaged between the designer and the plastics molding engineer on this point.

(2) The degree of accuracy and quality of surface finish required in the finished product must be closely considered in choosing the method of manufacture. The designer will have to elucidate whether the suggested design forms are such as will conduce to the obtaining of the necessary dimensional tolerances or the quality of finish desired, especially if close limits of dimensional variation have to be attained.

(3) Yet another very important problem to be settled at this stage is whether the proposed component design is capable of being reproduced satisfactorily, accurately and economically in the molding tools required for the job. This will particularly arise in the case of components which have to be produced as compression or injection moldings, or as extrusions.

A thorough and up-to-date knowledge of mold making methods and design requirements will be found invaluable to the component designer making such decisions. Knowing the character of the molds or other tools to be used, how they are made and ultimately operated, will enable him to foresee and forestall numerous difficulties which otherwise might later result in obstacles and added costs.

He will be able to select the most efficient type of tool for making his particular product, and also permit the component design forms to be more readily adapted to suit the requirements of tool and mold manufacture.

In the case of molding tools required for injection, compression, or transfer molding, it must be borne in mind that these have to be split at some point. This split usually is the cause of a flash on the finished part, which to some extent will be a source of disfigurement. Similarly, the component will have to be ejected in some manner from one half of the mold, and may require the use of ejector rods. These again are often a cause of surface blemish on the finished part.

(4) It will also be necessary to give some attention at this point to the relative costs of different processes of production. Numerous instances will occur where a particular component may be produced as a compression or injection molding, or to be built up from sheet or rod materials by welding or other fabricating methods. In these circumstances it may well be that manufacturing costs and especially unit cost per piece will become one of the main factors concerning decisions as to the most satisfactory manufacturing method.

Allied with the unit cost of components, will be the matter of mold or equipment cost. Very often with plas-

ic molding projects where only a moderate quantity of parts is required, this initial tool cost may be a critical factor in the selection of the manufacturing method.

In a very strict sense, costs should not influence the determination of purely theoretical design features at all, but issues are rarely as clear cut as this, a compromise has to be made. This is but an added reason why the designer should have a sound knowledge of the forming and molding process, so that advantage may be taken of any economies offered.

It will also prove exceedingly helpful if he has some knowledge of the relative cost of plastics materials. In general these are relatively expensive, especially compared to wood, or some of the commoner metals used in component construction. Additional material costs can usually be well met by reason of the very much higher rate of production achieved by molding methods.

Knowledge of this kind will sometimes enable the designer to balance higher material costs against lower production costs. For example, it may be that a component originally designed to have an extensive internal threading in a number of holes, will prove far more economical if the holes were to be cored plain so that they could be easily tapped after molding, rather than have to use a far more costly and intricate mold equipment with thread-forming cores.

On the other hand, it may be found that by including some simple provision in a mold, a very expensive or difficult machining operation may be obviated, the savings on which may more than recompense for the additional costs involved.

Another important point to be borne in mind when considering the cost angles of any plastics molding project, especially if the proposed component is to replace one previously made from metals, is that the degree of manufacturing scrap and waste will usually be very much smaller when using plastics materials than with metals. This is often advantageously reflected in the costing of production.

Likewise with respect to inspection and gauging. With wholly-machined metallic components, for example, the degree of inspection required to ensure that dimensional accuracy is being maintained may be quite considerable. Thus the cost of manufacture may be unduly increased on this account. With a plastics molded article, once the variations and snags of the initial stages of manufacture have been overcome and production has been stabilized, very little inspection may there-after be entailed. Thus costs will be reduced accordingly.

Fortunately in respect of the design and construction of compression- and injection-type molds, the component designer may anticipate some degrees of latitude, because several forms of layout of the molds may be available.

Certain forms are more easily reproduced in the mold and during production than others. Features may easily be incorporated, which on paper appear excellent, but which, when translated into tangible form during the manufacture of the tools and their later use, will not be so satisfactory because of the introduction of complications.

Injection Molding

With these molds the shape of the component has to be reproduced in a mold consisting of at least two main members. This is the minimum number of parts which can be employed, because of the necessity to open the mold after molding, in order to remove the injected component. The mold must be constructed in this manner, too, so that the cavity formations can be machined or formed into representative blocks by hobbing, machining, or some other tool-making method now in common use.

Not only must the shape of the component conform to these broad requirements, but it must be of such a type as will enable a split mold to be operated at economical speed.

There will be some restriction upon the overall size of mold to be used, a restriction which in its turn will influence the maximum size of component to be produced, the layout of cavity formations in the mold, number of cavities, etc.

In designing, therefore, for this class of molding it is a safe plan to fix the maximum weight of molded articles at not more than 85-90 per cent of the rated delivery of the machine. In the case of multiple impression molds involving the use of a complicated runner feed system, the effective volume of material available for producing components may be appreciably less than the above proportions.

A further restriction upon mold size is exerted by the size of the machine platens and the distance between its guide bars. The injection mold has to be mounted on platens in a certain relationship to the injecting nozzle and the machine guide bars. Thus the thickness and overall dimensions of the die surface will be controlled within specific limits by the size of machine to be employed.

The net effects of these limiting factors are to restrict in some degree the size of molded article which may be produced, the layout of cavities in the mold, and the number of impressions which may be economically inserted therein.

Compression Molding

With certain compression-type molds, somewhat similar restrictive factors arise. Like injection-type molds, compression molding tools have also to be split into at least two main portions to permit the machinist access for reproducing the cavity configurations and for ejecting the finished parts.

It is also very important with these tools to maintain the projected surface area of all cavity formations less than the compression capacity of the press. Failure in this respect may lead to various troubles during operation, such as partial formation of the component, under-curing of the material, or a lack of homogenity in the internal structure of the part.

Compression molding tools must be constructed with ample strength in order to resist the heavy pressures employed, and particularly to avoid distortion or crushing of the "land" surfaces, tendencies likely to arise because of the heavy tonnage on the press at each closure of the mold. The mold must also be provided with ample space for loading, a provision which will largely be determined, of course, by the grade of material used and its "bulk factor" value.

Limitations governing the overall size of a compression mold are not as close as those occurring with injection-type tools. For this reason molds of very large size and having very many cavity formations can be used quite successfully and economically.

Compression molds have to be affixed to the platens of the press, but the daylight opening between these platens of the machine is usually considerable. This feature is extremely valuable because it permits molds of considerable thickness to be used. This is often of the greatest advantage to the mold designer, as, for instance, when long, hollow components have to be produced. The cavity formations for parts of this kind may then be

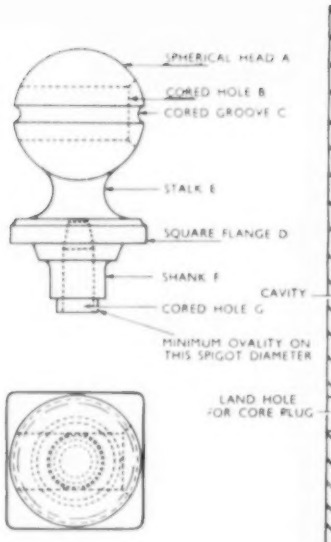

Fig. 1.

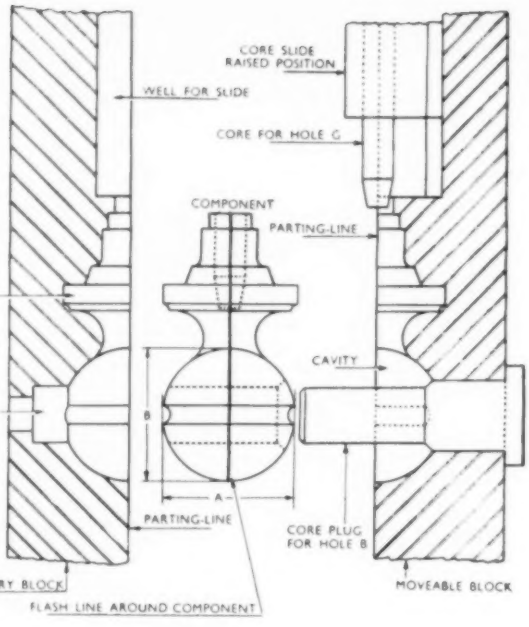

Fig. 2.

contained almost wholly within one-half of the mold, and the coring provisions, etc., carried in the opposed half.

Developed Component Design

To illustrate clearly the influence of a number of the above-mentioned factors in their practical application and effects, and the manner in which they may be counteracted, an actual example of a projected plastics molded component will now be considered in detail.

This will particularly indicate how the proposed original design form was modified to meet the exigencies of mold design and manufacture, and to improve the general appearance of the finished component. In addition, it is worth while noting that the modified form of component shape permitted a much higher rate of production, coupled with reduced mold charges and lessened unit cost per part.

A manufacturer required a small plastics molding of the kind illustrated at Fig. 1 for an industrial application, to replace one of identical shape which had been produced formerly in fairly large quantities, as a wholly machined metallic article. The complete shape of this metal component was taken over when designing the plastics component. It will then be seen that the shape of the component comprises the spherical head A, having a cored hole B running centrally through this portion. A cored groove C has to be located externally around the major diameter of the head. This groove is of semicircular shape, as shown.

Near the bottom end of the component is a square flange or base D, which is joined to the spherical head by the narrow stalk E. On the underside of the flange is a shank piece F consisting of three different diameters. This shank is also cored out hollow for the hole G, which extends almost the full length of the shank.

From the standpoint of mold design, construction and use, this particular shape possesses numerous rather serious snags and objections.

The component was required as an injection molded piece. To reproduce the shape of such an excessively undercut character as the area surrounding the stalk E, which is much smaller in diameter than the flange or the spherical head portions, would necessitate parting the mold along a line running transversely around the component.

This mold design requirement is clearly depicted at Fig. 2, which shows the component in the centre view, and the heavy solid line thereon denotes the position of the parting line of the mold. Some flash formation would occur along this line. This diagram also illustrates the manner in which the cavity formations have to be laid out.

The component would have to be molded upside down with the hollowed shank upper-most. This arrangement would prove more convenient for locating the necessary core plugs and core slide for hollowing out the shank F. The slide, etc., could be situated in the upper portions of the mold blocks.

The stationary mold block shown at the left-hand side is provided with half of the cavity formation, while the movable half of the mold at the right contains the other half of the cavity.

This indicates one of the major difficulties likely to arise in mold manufacture. It would be an exceedingly tricky business from the cavity machining point of view to ensure that the sides of the cavities at the parting-line surface of each block will be accurately matched up with each other when the mold is closed. Remembering, too, that it was proposed making this a multi-impression mold, it will be appreciated what a degree of precision would be entailed in determining this point, and the large amount of time involved in its achievement.

Secondly, the core plugs for producing the cored hole through the spherical head A would have to be mounted horizontally in the moving block, and extended sufficiently beyond the parting-line of that member to span the depth of cavity area in the opposed block and to pass slightly into a land or guide hole formed in the base of the cavity, in the manner depicted.

This would entail using a long core plug, from which the finished molding would have to be ejected when the mold was opened. The ejector rods to be employed for this function would therefore have to impinge upon the surface of the spherical head, which surface would thereby be formed with some collar flash at those points.

The hollow shank F will have to be formed by means of core plugs mounted vertically and carried in a slide member as shown. The upper portion of the movable block would therefore have to be machined to provide suitable retaining guideways for this slide. Because the core plug must be positioned with its vertical center exactly coinciding with the parting-line surface of the mold, the core slide would have to overhang from the movable block, and pass into a well or recess provided in the parting-line face of the stationary member, thus presenting another very accurate matching operation for the mold maker.

Some difficulty would also be experienced in machining the necessary cavity formations in the parting-line of each block. The most probable method envisaged for this purpose would embrace first machining in the guideways for the core slide, then mounting both halves

of the mold together, and setting the tool in the lathe for boring out the cavity formations. These would have to be very accurately disposed so as to lie exactly central on the parting-line of the mold.

The next undesirable feature associated with this design is that the finished article would undoubtedly possess some degree of ovality, especially on the spherical head portion. This would occur owing to the location of the mold parting in reference to the component.

The difficulties connected with the satisfactory production of a molded article of this shape would not be confined to the manufacture and use of the mold. Flash removal on the finished components would also present something of a problem to the molding engineer. It would be most difficult, for instance, to remove flashings from the sides of the stalk portion E and around the sperical head A. The great risk attaching to such a trimming operation would be that of partially destroying the spherical shape at such points.

The costs involved in producing a mold construction of this kind, having a multiplicity of impressions, were so great that upon being quoted the client immediately turned down the project on account of the heavy initial outlay on tools.

The whole project was referred back to the mold designer with the request that a thorough check-up be made to see if costs could be reduced. The potential customer at this stage also very wisely intimated his willingness to allow certain modifications to be made in the component shape and design features, a privilege which ought to have been made available at the very outset.

Upon duly considering the matter afresh, an alternative form of component shape was developed, as illustrated at Fig. 3. With this modified design it will be noted that the spherical head and the deeply undercut stalk portions, possessed by the original design, have been completely eliminated.

In their place a semi-spherical dome A is employed, this portion cresting a slightly conically shaped body B. Around the base of the domed portion is raised beading C. The hole D is cored centrally through the head as before.

This design employs the same square flange portion E, and the same stepped hollow shank as the previous example. This latter portion had to be maintained without variation to enable the part to be attached to another component during assembly.

Fig 4 gives a comparable mold block layout to indicate the numerous advantages and simplifications derived from the adoption of this form.

In the first place, it will be observed that the whole of the component shape up to the base of the flange to line A-A is contained within the stationary mold block shown at the left-hand side. This form of cavity layout entirely eliminates any flash line around the main portion of the molding. The stationary mold block is also equipped with a retracting core slide member arranged to move vertically in suitable guideways provided entirely within the block. The core for producing hole D is carried in this slide and passes clean through the cavity area. The movable block at the right is provided with a very simple portion of the cavity, i.e., that required for forming the stepped shank. A stationary core plug is housed centrally in this member, with the cavity formation therein, whereby the hollowed part of the shank may be formed.

The ejector rod mechanism is also mounted in this moving block members, as indicated by the dotted lines. It will be noted that the ejector rods now impinge upon the molded article on its bottom face on the flange portion. This is a relatively unimportant surface because the finished component is mounted upon another piece in such a manner as to seat down snugly on this face. The ejector rods in fact were left very slightly in advance of the parting line surface of the movable block so that very shallow circular depressions were formed on the flange base.

The great advantages obtained by the mold designer, mold toolmaker, and producer, by using this modified design form are briefly enumerated here, so that a comparison may be made with the disadvantageous features associated with the original form previously considered.

The whole of the critical cavity formation, viz., that required to produce the domed conical head portion, was contained wholly in a single mold block, being machined exactly at right angles to the parting-line surface. This much simplified machining operations and set-ups. The cavities were in fact readily formed by means of end-milling cutters, for roughing practically to size, and then by using a specially made end-milling D-shaped cutter to produce the final shape.

The manufacture of the cavity portions in the movable block could again be reproduced by a simple boring operation without difficulty.

The only accurate form of cavity matching required with this mold design was the correct centralization of the two cavity portions contained in the respective blocks. No matching was entailed in respect of the edges of the

(Continued on Page 43)

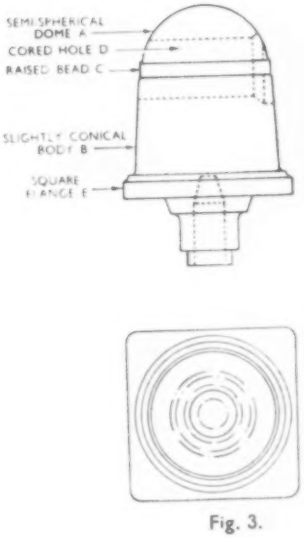

Fig. 3.

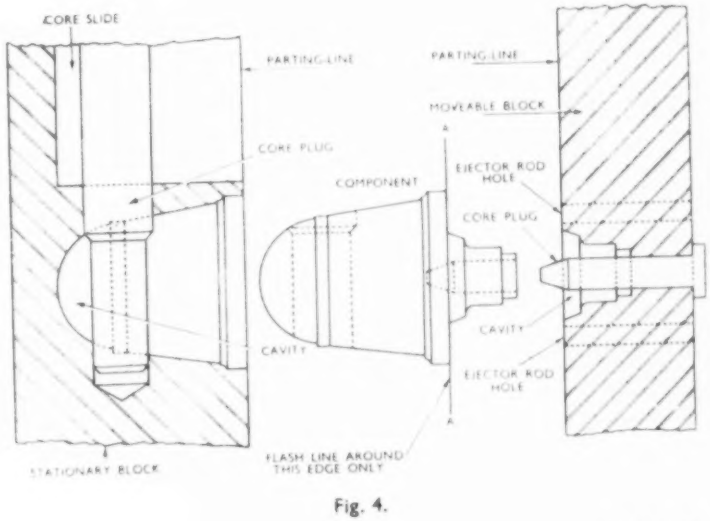

Fig. 4.

Molecular Engineering

(Continued from Page 27)

tically all plastics went to war, and to obtain them required, in most cases, a priority higher than that required for steel, because of their extensive use in military applications. They were used in such items as antenna housings on bombers, cowling for planes, fuse caps for shells, insulation for radar, water-lubricated bearings for the drive-shafts of warships, and for binocular cases. There were plastic helmet liners for our men under fire, plastic parts in every gas mask, in every proximity fuse, in every wakeless torpedo. The soldiers' emergency sulfa kit was protected and contained in a special plastic case. The Mae Wests of the bombing crews, the life rafts and even the oars, the water bottles, their raincoats, their mustard gas resistant clothing were all made of plastics. These were a few typical examples in which plastics offered decided advantages as materials of construction.

Plastics Advantages

Compared to other materials plastics offer these general advantages:

(1) They have a high strength to weight ratio.

(2) They are adapted to high-speed production.

(3) They are low in cost in large volumes.

(4) They permit the ready fabrication of odd and special shapes.

(5) They have very low heat conductivity and are warm to touch.

(6) They are good electrical insulators.

(7) They have a wide range of color, and beauty of finish, without requiring a surface coating.

(8) They have low water absorptions.

(9) They possess transparency and good optical properties without brittleness.

(10) They have good chemical resistance.

Our basic knowledge of polymers in general, and of plastics in particular, has accumulated at an astounding rate since 1941, and we no longer fear the stigma of substitute except as brought about by our own blunderings in misapplications. We have multiplied the examples which show that as the nature of the repeating unit in the polymer changes, different properties in the polymers are obtained. It has been demonstrated that in spite of the infinite number of polymers, there are only three species of polymers, namely, (1) Fibers, (2) Plastics, (3) Rubbers, and that the species into which a polymer fits is determined by the geometry of the chains, and the secondary valence or molecular attractive forces between these chains. If we represent as one extreme a polymer chain of such geometry that it will orient itself and fit perfectly into its neighboring chains, and be held there by high secondary valence forces, then we have described the perfect fiber. If we represent the other extreme by a polymer chain which establishes itself in a random and amorphous structure with very low attractive forces between the chains, then we have described the perfect rubber. The intermediate region between fibers and rubbers would then represent the region known as plastics, one border line of which would be fibers, dominated by plastic properties, and the other border line would be plastics, dominated by rubbery properties.

No Perfect One

Actually, we would hardly expect to find the perfect fiber, or the perfect rubber, and this makes it improbable that we will ever find the perfect plastic. Today, the polymer chemist is slowly approaching the point that, given the properties desired in a polymer, there is an excellent chance that by the proper selection of molecules, he will synthesize a polymer to meet the specification regardless of whether a rubber, or a plastic, or a fiber is demanded. We can also expect that the boundaries between the fiber, plastics, and rubber industries will continue to broaden and eventually to disappear. Many polymers with basic fiber properties will be used as plastics. Polymers considered once exclusively for the field of plastics will enter the domain of fibers as well as that of rubbers. The rubber chemist will extend the application of rubbery polymers into the field of plastics. The accomplishments in the field of polymers in the last few years justify this prediction. The polymers of ethylene, trifluorovinyl chloride, and tetra-fluorethylene, all truly fiber polymers, and unknown a few years ago, have now become industrial products used primarily as plastics. Acrylonitrile, an ingredient used in one type of synthetic rubber and in certain plastics, has now been converted to polymers and copolymers adaptable to the spinning of synthetic fibers, adding another family of man-made fibers to nylon, cellulose acetate, and rayon. Butadiene and styrene, the components of synthetic rubber, are now being used to produce tough, shatterproof plastics.

Optimistic

These were some of the trends in 1951, and in predicting the future, we must be guarded by the experiences of the present. This is more true of science than it is of the arts and literature. In literature and art, we seek and treasure old masters and editions, which have withstood the test of time. In science we rely on the latest editions because of its continuous progress. The latest edition tells us that the polymer of vinyl pyrollidone became an item of production to be used as a substitute for blood plasma.

When, in technology, we reach a stage where we can synthesize a polymer and substitute it for plasma in the pulsing veins of a living man, then I believe we have every right to be extremely optimistic as to the future of the plastics and polymer industries.

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SOUTHERN CAL. OFFICERS CHOSEN

The first technical meeting for 1952 Southern California Section, Society of Plastics Engineers, Inc., was held February 7th. A large representative group of members and guests was in attendance.

Retiring president Willard Lundberg, Plas-Tex Corporation, announced the new slate of officers for 1952, as follows: president, Clint Booth, Glenn H. Taylor Co.; vice-president, Dale McDonald, Reinhold-Geiger Plastics, Inc.; secretary-treasurer, Lou Talman, Dow Chemical Company; program chairman, Bob Whann, North American Aviation, Inc.

Election of three new Directors of the Southern California Section was announced as follows: T. D. Daniels, General Electric Co.; Dale McDonald, Reinhold-Geiger Plastics, Inc.; Lou Talman, Dow Chemical Co. The new Directors replace outgoing Directors Raul Rodriguez, Irv. White and W. Brandt Goldsworthy.

Holdover Directors are Willard Lundberg, Plas-Tex Corporation; Jack Wyckoff, Aero Plastics Company; Al Young, Plaskon Division, Libbey-Owens-Ford Glass Co.; Clint Booth, Glenn H. Taylor Co.; George Huisman, Plexolite Company; Bob Whann, North American Aviation Company.

Mr. S. S. Oleesky, Chief Engineer, Engineering Research and Development Reinforced Plastics Consultants and Engineers (formerly with Naval Air Development Center) was the speaker for the evening. He gave a most interesting and educational talk on "Plastics in Airborne Electronics Applications."

CRATER IS NPA PLASTICS CHIEF

Willard deCamp Crater, Jr. has been appointed chief of the thermoplastics section, Chemical Division, National Production Authority in Washington, D. C., it was announced today.

Mr. Crater, who is the assistant manager of vinyl sales for the Naugatuck Chemical Division, United States Rubber Company, has been given a leave of absence by the company in order to assume the government post.

He is a member of the New York and Washington Rubber Groups of the American Chemical Society, the Wire Association and is past president of the Baltimore-Washington section of the Society of Plastic Engineers.

MIAMI VALLEY VISITS PUBLISHING PLANT

Officers For 1952 Are Announced

John L. Russell

Miami Valley Section members of the Society of Plastics Engineers, Inc. visited the McCall Corp. plant on Thursday, February 7 and enjoyed a tour through this mammoth publishing company. 36 members and 13 guests were conducted in groups and very ably led by guides John Whitlock, Personnel; Charles Wolfe, Production; Homer Skidmore, Pre-Press; and Jack Corbin, Engineering. The 28 year old McCall plant covers 22.5 acres, prints approximately 1,500,000 magazines daily, besides 150,000 dress patterns and uses 18,000,000 pounds of paper and 400,000 pounds of ink each month. The company employs 3000 and prints such widely known periodicals as Readers Digest, Redbook, McCalls, Outdoor Life, Popular Science and Newsweek. Marty Kasch was program chairman.

Marvin Winemiller, Recto Molded Products, Cincinnati, our Fellowship Chairman presented Joseph Merke, Plastics Moldings Corp., Cincinnati and a Director of Miami Valley Section, a prize for extending good fellowship to a guest. Birthdays announced for February were those of Ross Vines, George Whittles, David Hawk, and R. Kohler.

Dick Bice, Formica Insulation Co., Cincinnati, is the Program Chairman for the March 6 meeting and trip through the new Formica Plant in suburban Cincinnati. Dinner will precede the Formica trip and the featured speaker at the meeting will be G. H. Clark, Vice-President in charge of Engineering at Formica, and a well known figure in the plastics world.

Merle Nelson, Pres.

Our past president and retired Director of Miami Valley Section has distributed a recently completed up to date roster to each of the members. It discloses a total of 91 members, of which 50 are from Dayton and 30 from Cincinnati.

New officers are: Merle Nelson of Plastic Moldings, President; Charles Selz of Kurz-Kasch, Vice-President; Ralph Backscheider of Recto Molded Products, Secretary; Paul A. MacPhee of National Cash Register, Treasurer.

STYRENE MOLDING INTERESTS NEW YORK

British Visitors Welcomed; Committees Named

Arthur M. Merrill

The New York Section started the year with a bang with a near-record attendance of 115 members and guests at its first regular "at home" meeting, held on February 20 at the Gotham Hotel. The meeting included a cocktail hour, dinner, business session, and technical session.

Featured speaker at the technical session was Henry W. Wehr, technical service representative, Dow Chemical Co., who discussed "Styron Technology of Injection Molding," and showed the Dow film, "Inside the Injection Mold." Mr. Wehr began his talk with a description of the Dow plastics organization and the work of the technical service department. Much work is being done on the polystyrene injection molding cycle by means of special test molds containing instruments to measure pressure and temperature inside the mold. The speaker discussed the typical pressure-temperature curve for styrene, and the effect on this curve of variations in temperature, pressure, nozzle opening, and plunger dwell time. These effects were also illustrated in the film, as well as styrene flow characteristics around inserts of different sizes and shapes. One of the points established in this study is the importance of proper sealing pressure, since higher or lower pressures will cause sticking, sink marks, or other defects. With regular or large gates a mechanical cut-off is needed to prevent plastic from leaking out of the mold as the plunger is withdrawn. The ball-check nozzle provides such mechanical action, minimizes leaking, and permits a more gradual decline of pressure inside the mold as the plastic solidifies.

Committee chairmen for 1952 were announced during the business session, as follows: program, Harold H. Schwartz, Empire Brushes, Inc. (to June 30th); membership, Richard M. Thews, Monsanto Chemical Co.; credentials, George Baron, Ideal Plastics Corp.; house, William Lewi, Dusal Tool & Mold Co.; favors and prizes, Russell H. Skidmore, Celanese Corp. of America; employment, G. Palmer Humphrey, G. P. Humphrey Plastics; and publicity, A. M. Merrill, "India Rubber World."

Section president Bruno E. Wessinger, Wess Plastic Molds, Inc., welcomed the guests present, including a 16-man United Kingdom Plastic Molding Productivity Team recently arrived to study the American plastics industry under the sponsorship of the Mutual Security Agency (formerly the ECA). The team leader, A. L. Sparshott, Witton Moulded Insulation Works, Ltd., spoke briefly on the aims of the mission. William M. Cox, Chelsea Vocational High School, New York City, also spoke on the course in plastics fabricating being given at Chelsea, and urged the active cooperation of the local plastics industry in establishing a more comprehensive vocational course of study in plastics technology.

Table favors were distributed through the courtesy of Amalite, Inc., and Dow Chemical Co. The meeting closed with a drawing for door prizes contributed by Baby World, Inc., Brilhart Plastics, Inc., Celanese Corp. of America, and Wess Plastic Molds, Inc., and won by Geoff Stanley, British Plastics Federation; William Tyrrell, Molding Specialists, Inc., Sam Stone, Nordan Plastics Corp.; and J. S. Spear, Sarco Co., Inc.

A total of 13 new members have been added by the New York Section since the first of the year. These new members are as follows: Harry W. Buchanan, Metal & Thermit Corp.; Robert W. Dailey, Amos Molded Plastics; Howard S. Dudley, American Cyanamid Corp.; Edmond Gabriel, Gabriel Mfg. Co.; Jacob B. Gitner, American Molding Powder & Chemical Corp.; Saul Gobstein, American Molding Powder & Chemical Corp.; George A. Gould, A. Bamberger Corp.; Anton and Boris A. Jackson, both of U. S. Tool & Mfg. Co., Inc.; Max Klueger, Omni Products Corp.; Burton L. Lilling, Supreme Wire & Cable, Inc.; Miles Powell, Jr., E. I. du Pont de Nemours & Co., Inc.; and B. Martin Stregack, A.B.S. Mfg. Co., Inc.

N. W. Penn

(Continued from Page 5)

Consistent with his established reputation as a creative engineer, Ed knocked off national honors and a $50 cash prize for winning the SPE pin contest.

Dick Welch became connected with Nosco Plastics as of February 1, 1952, in the capacity of Tool Engineer. Dick is well known in the area having recently held a key position at Byrd Tool & Mold Co.

PROVIDENCE PANEL ON PLASTICS APPLICATIONS

Change In Meeting Date Increases Attendance

Richard H. Bruce

The Society of Plastics Engineers, Rhode Island and Southeastern Mass. Section met Wednesday, January 9th at the Wayland Manor Hotel, Providence, R.I. to hear Mr. Ely G. Greninger, Supervisor of Manufacturing Engineering, Hemco Plastics, Division of Bryant Electric Company, discuss "The Use of Plastics in the Electrical Industry." Mr. Greninger's 32 years of experience in the wiring device industry of which 14 years have been spent in product design, provided an excellent background which enabled him to highlight his discussion with many interesting anecdotes and methods developed over his years in this business.

On Thursday, February 14th, our meeting was held at the Wayland Manor Hotel, Providence, R.I. with a better than usual attendance. The subject of this meeting was "Panel Discussion of Latest Developments in Plastic Materials and Application." Speakers on the panel were Mr. Robert Johnson, Monsanto Chemical Company, Mr. P. Huidekoper, Plaskon Division, Libbey Owens-Ford Glass Company, Mr. E. W. Callahan, General Electric Company, Taunton, Mass., and Mr. Richard H. Bruce, Bakelite Company.

It has been customary for the Rhode Island Section to hold meetings on the second Wednesday of each month. It has been the opinion of the Board of Directors that the disruptive influence of televised fights on Wednesday nights together with the bowling activity in this area may have been influencing our attendance. Accordingly, the monthly program will be offered on various evenings throughout the month until the most popular date has been ascertained. Since this meeting was held on the second Thursday, a very satisfactory increase in attendance was enjoyed. Plans are being made to hold the March meeting on the third Thursday to observe the attendance response.

DETROIT DIRECTORS AND OFFICERS ANNOUNCED

Emil R. Gazdick

Last years elections have brought three new directors to the Detroit Section Board of Directors. They are as follows:

Erik Erikson—Detroit Plastic Products; Courtney White — Hercules Powder Co.; Emil R. Gazdick—Evans-Winter-Hebb, Inc.

These men will serve for a term of three years in accordance with the Constitution and By-Laws of the National S.P.E.

The remaining members of the Detroit Board of Directors are: Harry Haaxma—Wolverine Plastics Co.; Ray Richards—Bakelite Corp.; Wm. DeGalan—Koppers Corp.; John Totten—Ford Motor Co.; Don Hoffman—Evans, Winter, Hebb, Inc.; Walter Kosy—Chrysler Corp.

At a recent meeting of the Board of Directors the following officers were elected for 1952:

President—Harry Haaxma, Wolverine Plastics Co.; V. President—Wm. DeGalan, Koppers Corp.; Secretary—Courtney White, Hercules Powder Co.; Treasurer — Erik Erikson, Detroit Plastic Products.

The appointment of committee chairmen has not been completed and so at this writing is not ready for publication.

At board meetings Mr. Haaxma has outlined a goal for the Detroit Section of increasing interest in the various affairs of the society. In this respect it is felt that more effort by the chairmen and their committees in the performance of their duties could be one of the most important factors.

NEWARK SETS NEW ATTENDANCE RECORD

Bailey Speaks on Extrusion of Thermoplastics

Anthony Naturale

Members and guests totaling more than 175 were present at the monthly meeting of the Newark Section, held February 13, 1952, to witness an address on the subject "Extrusion of Thermoplastics" given by Mr. James Bailey.

Mr. Bailey, who is Vice-President and Director of Research of the Plax Corp., Hartford, Conn., discussed extrusion generally, outlining the fundamental principles. His address, illustrated with slides, covered the history and development of the extrusion field from the standpoint of raw materials, equipment and products produced by this process. The advantages, economics and demand of extruded plastic products were also briefly discussed, during which Mr. Bailey mentioned that he feels the plastic industry has only begun to scratch the surface of the potentials of this molding process.

Following Mr. Bailey's well presented topic, there was a panel discussion conducted by a group of extrusion technologists from the various plastics companies in and around New Jersey. The questions and problems presented by the members and discussed by the panel proved very interesting. Mr. Gerald Heldrick of Gering Products acted as moderator.

Watson-Stillman Co., Detroit Mold Engineering Co., Mack Molding Co. and Celluplastic Corp. in cooperation with the American Plastics Industry, were hosts to the Austrian Plastics Productivity Term during its visit to New Jersey.

The next meeting was held on March 19, 1952. Mr. Peter J. Gaylor of Gaylor, Cifelli & Jurick, Patent Attorneys of Newark, N.J. spoke on "Inventions and their effect on living." Following Mr. Gaylor's talk a film entitled "An Exact Duplicate" was shown through the courtesy of George Gorton Machine Co., of Racine, Wisconsin.

STYRENE HISTORY INTERESTS PHILLY

A. J. Kissileff

The Philly Chapter had an unusual meeting in February. One that created a renewed interest in the efforts of this years' Officers to keep the attendance at a continuing high level.

George Koch, local Prez, introduced the new National Prez, our own Bill Bracken. Highlight of the meeting was an address by A. J. Warner of Federal Tele Communication Laboratories, a former President of the Newark, N. J. Chapter, SPE. Mr. Warner, whose topic was "Polystyrene," presented an exciting history of the material, outlining its progress from as far back as Revolutionary days. Incredible as this appeared to be, Mr. Warner was able to trace the material with substantiating facts back to the days when—according to our schoolbooks, George Washington could make a dollar go much further than we can today, with Mr. Truman on the throwing end.

Through the courtesy of Merrill Lynch, Pearce Fenner and Beane, the membership had the privilege of viewing a film called "Fair Exchange," a story of how and how not to invest money in get-rich-quick stock deals. While this was quite a departure from the Plastics Industry, it was educational and most timely.

It seems that door prizes are becoming more and more popular in Philly. For the first time since the January meeting of 1951, the guest speaker failed to draw either his own

number, or that of the chairman of the evening.

The largest turnout in the history of the Philadelphia group made January's meeting unusually successful.

The new president, George Koch, introduced the newly elected Board of Directors to well over 100 members and guests, and outlined a program for 1952 that met with considerable enthusiasm.

Guest speakers were: William B. Campbell, Project Engineer of U. S. Gasket Co., who highlighted some interesting experiences with Teflon and Kel-F in unusual applications.

Jules Jupa, M. W. Kellogg Plastics Engineer, who spoke on properties and manufacture of Kel-F.

George Neilsen, DuPont Plastics Engineer, who also spoke on properties and manufacture of Teflon.

These men formed a panel for discussion of the fluorocarbon polymers, during which questions and answers produced much valuable information that never appears in the usual technical bulletins.

Following Mr. Reber's address, Mr. F. Reed Estabrook, Jr. of Northern Industrial Chemical Company moderated a four man debate on the controversial issue "Resolved: That Engineering Know-How in the Field is More Important to Customer Relations than Engineering Know-How in the Plant." Pro were Bernard Thal, The Bolta Co. representing the Custom Molder Salesman, and Prescott Huidekoper, Jr., Plaskon Div., Libbey-Owens-Ford Glass Co. representing Material Salesmen. Contra were C. P. McIver, Victory Plastics, representing Proprietary Molders, and Fred Murphy, Standard Plastics Co. representing Custom Molders. It was a toss-up as to the winners.

EASTERN NEW ENGLAND OFFICERS NAMED

New Plastigels Described; Extrusion Discussed

Robert C. Davenport

February Meeting

Annonuncements of this year's Chapter Officers were made by the President, Mr. James F. Lang of the Bakelite Corporation. They were as follows: Vice President, Mr. Frederick Langhorst of the Stanley Chemical Co.; Secretary, Mr. Melvin S. Haas of the Bolta Co.; and Treasurer, Mr. Jack Queeny. Committeemen are: Credentials, Mr. Sylvan S. Simon of the Bolta Co.; House, Mr. Langhorst; Program, Mr. Richard Beckwith of the Dow Chemical Co.; Membership, Mr. John T. Moore of Tennessee Eastman Co.; Publicity, Mr. Huidekoper; and SPE Reporter, your correspondent of the Bolta Co. It was also announced that Mr. John LaBelle of the Koppers Co., our representative on the Board of the National Organization, has been elected as the National Secretary.

At our February meeting at the Beaconsfield almost one hundred members and guests came to hear our speaker, Dr. Edward T. Severs, Senior Fellow of Organic Synthesis Development at the Mellon Institute, Pittsburgh, Pa. Dr. Severs' subject was the extremely new development, 'Plastigels.'

'Plastigels,' those special purpose materials, are the result of a marriage between 95 parts (approximately) of 'Plastisol' and 5 parts of a gelling agent, as explained by Dr. Severs. 'Plastisols' may be 60 parts plasticizer, such as DOP, to 100 parts of resin. The gelling agents are organophilic groups which act as network formers. The resultant putty-like substance may be molded or extruded without heat. Fusing the material causes it to be converted to a solid solution in which state it will withstand rougher handling.

'Plastigels' are so new that few products have yet been made from them. The question Dr. Severs posed was, 'Where can they be useful to you?'

No meeting will be held in March. The next two sessions will be held April 17th and May 15th, speakers and topics to be announced. We will then recess for the summer vacation. Chapter members are urged, meanwhile, to consider where they may best serve to make the 9th Annual Technical Conference the best one. Remember, Convention of SPE to be in Boston '53.

January Meeting

The Eastern New England Section of the SPE opened its 1952 sessions in an enthusiastic, well attended joint meeting with the Boston-Providence Section of the SPI at the Beaconsfield Hotel in Boston. After the usual preprandial hour, ninety members and guests sat down to dinner.

Mr. Clarence Reber, Development Engineer with the Plax Corp. for the past six years, gave a slide-illustrated lecture on "Present Day Extrusion of Thermoplastics."

Reber discussed two phases of operation—choice of heating and method of shaping the extruded part. For heating, either electrical or heated fluid types of extruder may be used. He observed that the electrical heat has the advantage of not only being hot but also being clean, but has the disadvantage of requiring expensive controls and auxiliary cooling equipment. The heated fluid type provides uniform heat, needs fewer controls and no coolant, but is limited in temperature range and is subject to leaks. Minimizing the first of these limitations is the growing availability of high temperature fluids.

Turning to shape control, he explained the three types: Off-Hand, Semi-Positive, and Positive. The Off-Hand method pushes the thermoplastic through the die, taking it up as it is produced without other controls or limits. The Positive method utilizes cooling dies, water baths, controlled pull-down, and all other devices necessary for absolute control of the extruded product. Obviously, the Semi-Positive method fell in between these two in equipment used and results achieved.

Successful Design

(Continued from Page 39)

cavities. Mold manufacturing costs were, in fact, substantially less than in the first instance, due to the great simplifications in mold construction.

The finished component is free from any tendencies towards ovality since the whole of the essential portion of the part is formed from a cavity cut into a one-piece block.

Flash formation would only occur along the line A-A. Since this lies at the extreme edge of the squared flange no difficulties would arise in its removal. A simple type of push-through trimming die could be employed to de-flash the parts without risk of injuring its correct shape.

The operation of this type of mold also proved considerably more simple and quicker than could be anticipated with the mold design depicted at Fig. 2. This permitted the quotation of a lower unit cost per piece, as well as much lower mold charge, than was possible with the original example.

The appearance and quality of finish of this modified form of component was much superior to that which would have been possible using the original component design form.

(to be continued)

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New Books

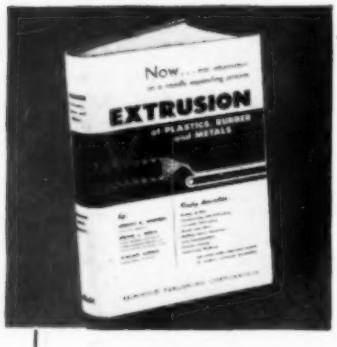
Extrusion of Plastics, Rubber and Metals by Simonds, Weith and Schack. Reinhold Publishing Corp.

"Extrusion" is a notable book in two regards. First, it fills a gap in the plastic literature, a literature which is becoming of age and keeping abreast of the rapid development of the industry. Second, it represents the kind of book which is of greatest use to the most people. That is, not only are the processes and problems of extrusion thoroughly covered, but at such a level as to be immediately understandable and useful to the average shop man as well as to the executive.

Extrusion machines and dies are discussed in detail, as are the materials and their extrusion behaviour and necessary treatment. The economics of cost vs. selling price and the cost of setting up an extrusion shop are the subject of a chapter.

The book is exceptional in the number of concrete examples shown and discussion of molding problems and their causes.

Three-fourths of the book is devoted to plastics. There is one chapter on the theoretical aspects, but by and large this book is for the practical man. "Extrusion" should be a valuable addition to the library of anyone in the field.



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